91xx pH/Electrolyte Analyzers

Service Manual

Roche Diagnostics

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For more information, see:
Software on page G-5
Service Manual on page G-6

Edition notice

91xx pH/Electrolyte Analyzers Service Manual

This Service Manual is for the maintenance and repair of 91xx pH/Electrolyte Analyzers (9110 pH Analyzers and 9120, 9130, 9140, 9180 and 9181 Electrolyte Analyzers).

91xx pH/Electrolyte Analyzers

Every effort has been made to ensure that all the information contained in this manual is correct at the time of printing. However, Roche Diagnostics GmbH reserves the right to make any changes necessary without notice as part of ongoing product development.

Any customer modification to the instrument will render the warranty or service agreement null and void.

Software updates are done by Roche Service representatives.

9180 Electrolyte Analyzers SN > 12001 are IVD compliant.

Intended use

This manual contains all of the information required for maintenance and repair of 91xx pH/Electrolyte Analyzers (9110 pH Analyzers and 9120, 9130, 9140, 9180 and 9181 Electrolyte Analyzers).

The user must be familiar with the function and operation of the instrument to fully understand the processes described here.

For more information about 91xx pH/Electrolyte Analyzers, refer to corresponding Instructions for Use.

Observe the service and repair procedures described in this manual and use only genuine Roche replacement parts and Roche-approved materials to guarantee the full functionality of the 91xx pH/Electrolyte Analyzers.

For the order numbers of replacement parts, refer to:
91xx pH/Electrolyte Analyzers Spare Part List

For an overview of possible revisions and available software versions, see:
Software on page G-5
Service Manual on page G-6

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Contents

Version History 3
Edition notice 3
Intended use 3
Copyrights 4
Trademarks 4
Contact addresses 4
Contents 5
Preface 9
How to use this manual 9
Where to Find Information 9
Conventions used in this manual 10

System Description Part A

1 Safety information
Important information A-5
Operating safety information A-6
Important notes and warnings A-6
Disinfectants A-7
Deproteinizer A-7
Other disinfectants A-7
ESD protection measures A-8
Explanation of the phenomenon A-8
Influence of electrostatic charges on components A-8
Why is ESD protection so important today? A-9
How can ESD protection be guaranteed? A-9
Conclusion A-9

2 Specifications
Specifications A-13
Specifications A-13
Operating Parameters A-13
Classifications A-15

3 Interface specifications
Interface specifications A-19
Interface information A-19
Example data string information A-20
Data Link Information (9180/9181 only) A-20

4 Description of modules
Description of modules A-23
Mechanical assemblies A-23
Fluidic Module A-27
Electronics A-33

5 Electronic diagrams
Electronic diagrams A-39
9110 analyzer block diagram A-39
9120, 9130, 9140, 9180 analyzer block diagram A-40
9181 analyzer block diagram A-41
System interconnect - 9110, 9120, 9130, 9140 A-42
SBC PCB - power supply - 9110, 9120, 9130, 9140 A-43
SBC PCB - valve drivers - 9110, 9120, 9130, 9140 A-44
SBC PCB - pump motor driver / door detect - 9110, 9120, 9130, 9140 A-45
SBC PCB - input amplifiers - 9110, 9120, 9130, 9140 A-46
SBC PCB - temperature circuit - 9110, 9120, 9130, 9140 A-47
SBC PCB - analog selector and A/D converter - 9110, 9120, 9130, 9140 A-48
SBC PCB - microprocessor - 9110, 9120, 9130, 9140 A-49
SBC PCB - printer display drivers - 9110, 9120, 9130, 9140 A-50
Printer daughter PCB - 9110, 9120, 9130, 9140, 9180, 9181 A-51
Lamp PCB - 9110, 9120, 9130, 9140 A-52
Display daughter PCB - 9110 A-53
Preheater PCB - 9110 A-54
Display daughter PCB - 9120, 9130, 9140 A-55
System interconnect - 9180, 9181 A-56
SBC PCB - power supply - 9180, 9181 A-57
SBC PCB - valve drivers - 9180, 9181 A-58
SBC PCB - pump motor driver/door detect - 9180, 9181 A-59
SBC PCB - input amplifier - 9180, 9181 A-60
SBC PCB - temperature circuit - 9180, 9181 A-61
SBC PCB - analog selector and A/D converter - 9180, 9181 A-62
SBC PCB - microprocessor - 9180, 9181 A-63
SBC PCB - microprocessor - 9180, 9181 A-64
SBC PCB - Fluid pack detector - 9180, 9181 A-65
Lamp PCB - 9180, 9181 A-66
Display daughter PCB - 9180 A-67

Software operation Part B

6 Software operation 9110
Software operation 9110 B-5
Overview B-5
Overall program operation flow B-6
Main menu B-7
Measurement sequence B-8
Print functions menu B-9
QC sample menu B-10
Daily maintenance menu B-11
Operator functions menu B-12
Program instrument menu B-13

Service functions menu B-14
Calibration sequence B-15

7 Software operation 9120, 9130, 9140
Software operation 9120, 9130, 9140 B-19
Overview B-19
Overall program operating flow B-20
Main menu B-21
Measurement sequence B-22
Print functions menu B-23
QC/standard/urine sample menu B-24
Daily maintenance menu B-25
Operator functions menu B-26
Program instrument menu B-27
Service functions menu B-28
Calibration sequence B-29

8 Software operation 9180
Software operation 9180 B-33
Overview B-33
Overall program operation flow B-34
Main menu B-35
Measurement sequence B-36
Print functions menu B-37
QC/standard/dialysate/urine sample menu B-38
Daily maintenance menu B-39
Operator functions menu B-40
Program instrument menu B-41
Service functions menu B-42
Calibration sequence (1) (Example Na/K/Li calibration) B-43
Calibration sequence (2) (Example Na/K/Li calibration) B-44
Power-up B-45

9 Software operation 9181
Software operation 9181 B-49
Overview B-49
Overall program operting flow B-50
Main menu B-51
Manual measurement sequence B-52
Automated measurement sequence B-53
Print functions menu B-54
QC/std/dialysate/urine sample menu B-55
Daily maintenance menu B-56
Operator functions menu B-57
Program instrument menu B-58
Service functions menu B-59
Calibration sequence (1) (example Na/K/Li calibration) B-60
Calibration sequence (2) (example Na/K/Li calibration) B-61
Power-up sequence B-62

10 Service functions
Service functions B-65
TEST ELECTRODES B-65
TEST SAMPLE SENSOR B-65
TEST SnapPak SENSOR (9180 and 9181 only) B-65
TEST LANGUAGE SWITCH (9180 and 9181 only) B-65
TEST SAMPLE DOOR (except 9181) B-66
TEST PROBE (9181 only) B-66
TEST AUTOSAMPLER (9181 only) B-66
TEST PUMP B-66
TEST PINCH VALVES B-67
TEST INTERFACE B-67
TEST AMPLIFIER B-67
ENTER SERVICE CODE B-67
Miscellaneous functions B-69

Maintenance Part C

11 Adjustments
Adjustments C-5
Sample contacts adjustment (9110 only) C-5
Sample sensor adjustment (9120/9130/9140/9180/9181 only) C-5
Temperature Adjustment (9110/9140/9180/9181 only) C-6

12 Maintenance
Maintenance C-9
Daily maintenance C-9
Weekly maintenance C-9
Monthly maintenance C-9
Six month maintenance C-9
Annual preventive maintenance C-9

Troubleshooting Part D

13 Troubleshooting
Error messages and troubleshooting D-5
Status-LEDs D-5
STATUS: NOT CALIBRATED D-5
STANDARD A NOT DETECTED D-5
STANDARD B NOT DETECTED, STANDARD C NOT DETECTED (9180/9181 only) D-6
CHECK SAMPLE CONTACTS(9110), CHECK SAMPLE SENSOR (9120/30/40/80/81) D-6
CHECK REFERENCE HOUSING D-7
PLEASE CLOSE SAMPLE DOOR (except 9181) D-7
NO SAMPLE D-8
CLEANING FLUID NOT DETECTED D-8
CONDITIONING FLUID NOT DETECTED (except 9110) D-8
INTERFACE ERROR D-9

PAPER JAM OR PRINTER DEFECT D-9
CHECK ELECTRODES D-9
NOT CAL'D D-9
CLOG IN SAMPLE PATH (9110 only), CLOG
CHECK FLUID PATH (except 9110) D-11
↑↑↑↑ ↓↓↓↓ (Out of range) D-11
↑ ↓ (Temparature out of range) D-11
ERR D-12
PERFORM DAILY MAINTENANCE (except 9110)
D-12
REPLACE FLUID PACK D-12
CHECK TEMPERATURE (9140/9180/9181 only)
D-12
VALVE OVERTEMP! CHECK VALVES D-13
ERROR: UPPER NEEDLE SENSOR D-13
ERROR: LOWER NEEDLE SENSOR D-13
WHEEL MISSING OR SAMPLER DEFECT D-13
SAMPLER JAMMED OR DEFECTIVE D-14

Glossary **Part E**

Glossary E-3

Index **Part F**

15 Index

Versions **Part G**

16 Versions
Software G-5
Service Manual G-6
Version 1.0 G-6
Version 2.0 G-6

Preface

This manual contains all of the information required for the maintenance and repair of the 91xx pH/Electrolyte Analyzers.

The user must be familiar with the function and operation of the instrument to fully understand the processes described here.

For more information about instructions, refer to:
9180 Electrolyte Analyzers Instructions for Use

Observe the service and repair procedures described in this manual and use only genuine Roche replacement parts and Roche-approved materials to guarantee the full functionality of the 91xx pH/Electrolyte Analyzers.

For the order numbers of replacement parts, refer to:
91xx pH/Electrolyte Analyzers Spare Part List

For an overview of possible revisions and available software versions, see:
Software on page G-5
Service Manual on page G-6

How to use this manual

- *Keep this Service manual in a safe place to ensure that it is not damaged and remains available for use.*
- *This Service manual should be easily accessible at all times.*

To help finding information quickly, there is a table of contents at the beginning of the book and each chapter. In addition, a complete index can be found at the end.

Where to Find Information

In addition to the Service manual, the following documents are also provided to assist in finding desired information quickly:

- 91xx pH/Electrolyte Analyzers Instructions for Use
- 9180 Electrolyte Analyzer Short Instruction
- 91xx pH/Electrolyte Analyzers Service manual (PDF or iSDoc version in GRIPS)
- 91xx pH/Electrolyte Analyzers Spare Part List (PDF or iSDoc version in GRIPS)

Conventions used in this manual

Visual cues are used to help locate and interpret information in this manual quickly. This section explains formatting conventions used in this manual.

Symbols The following symbols are used:

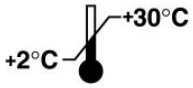
Symbol	Used for
►	Start of procedure
•	List item
👁	Cross-reference
☞	Call-up (software reference)
	Note All sections or text locations marked with "NOTE" describe safe procedures that are intended to provide the user with additional help.
	Caution All sections or text passages that are marked with this symbol describe procedures or indicate conditions or dangers that could damage or lead to malfunctions in the instrument, and which therefore should never be attempted.
	Warning Sections marked with this symbol contain information that must be observed for the prevention of personal injury (to patients, users or third parties).
	Risk of infection! (according to the standard DIN EN 61010-2-101:2002) (Instrument)
	Risk of infection! (according to the standard DIN ISO 15223-1:2005) (Consumables)
	High Voltage Passages that are marked with this symbol warn of an immediate danger in connection with electrical wiring or components.
	ESD protection measures All sections or passages that are marked with this symbol warn of specific dangers in connection with static discharge. Packages that are marked with this symbol must only be opened by trained technical staff.

For more information about ESD protection measures, see *ESD protection measures* on page A-8.

IVD symbols

Instruments: applicable for 9180 Electrolyte Analyzers SN > 12001.

The IVD symbols are used in accordance with DIN EN 980:2003, ISO 15223:2000 (as per the In Vitro Diagnostics Directive 98/79/EC), and DIN EN ISO 780:1997.

Symbol	Description
	This product complies with the requirements in the directive 98/79/EC on in vitro diagnostic medical devices.
	Lot designation
	Consumables: use by... (expiry date) The consumables must be completely consumed by the indicated date. If a day is not indicated, apply the last day of the respective month.
	Store at ... The conditions necessary to preserve the product's shelf life before opening.
	For in vitro diagnostic use
	"Grüner Punkt" (in Germany)
	Manufacturer — according to directive 98/79/EC on in vitro diagnostic medical devices
	Store upright
	Risk of infection! (according to the standard DIN ISO 15223-1:2005) (Consumables)
	Catalogue number
	Caution (refer to accompanying documents). Please refer to safety-related notes in the manual, accompanying this instrument.
	Please consult instructions for use
	Serial number (model plate)

Other symbols The following symbols are listed as additional information:

Symbol	Description
	Electrodes: This date indicates the limit of the maximum storage time of an electrode. The electrode must be installed in the instrument no later than the imprinted date. If the installation takes place on the imprinted date, it still falls within the specifications. The calculation of the “Install before” date is based on the production date of the elctrode.
 T: R23/33/50-53	Danger symbol: T: Toxic (on the packaging of the reference electrode) **Rating:** Inhalation, swallowing or skin contact with even small quantities can lead to serious health risks, including fatal risks. Characteristics of this type of item are severe, possible irreversible damage to health through repeated or prolonged contact, particular with carcinogenic, genetic or reproductive (danger to reproductive capabilities) effects. **Caution:** Avoid any contact with the human body. If you feel unwell, contact a doctor immediately. Any substances with carcinogenic, genetic or reproductive dangers are indicated appropriately. Always observe the regulations when handling such substances.
 N: S45/60/61/7	Danger symbol: N: Dangerous to the environment (on the packaging of the reference electrode) **Rating:** If released into aquatic and non aquatic environments, can cause immediate or delayed damage to ecosystems through a change in environmental conditions. These substances or their by-products can cause simultaneous damage to sensitive environmental areas. **Caution:** Depending on the potential for damage, do not allow the substance to enter sewers, soils or the environment. Observe the specific disposal regulations.
 XI: R36/37/38, S 26-37	Danger symbol: Xi: Irritant **Rating:** Although not corrosive, momentary, longer-lasting, or repeated contact with skin or mucous membrane may result in inflammation. Danger of sensitization during contact with skin (when classified with R 43). **Caution:** Avoid contact with eyes and skin, do not inhale vapors.
	Do not use content if the packaging is damaged
	Protective gloves, protective goggles and suitable protective clothing must be worn

Abbreviations The following abbreviations are used:

Abbreviation	Definition
A	
ADC	Analogue to digital converter
ANSI	American National Standards Institute
C	
CMOS	Complementary Metal-Oxide Semiconductor
E	
EEPROM	Electrically erasable programmable read-only memory
e.g.	*exempli gratia* – for example
EC	European community
EN	European standard
ESD	Electrostatic Discharge
H	
HIV	Human Immunodeficiency Virus
HW	Hardware
I	
IEC	International Electrical Commission
ISE	Ion selective electrode
IVD	In vitro Diagnostics
L	
LCD	Liquid Cristal Display
LED	Light Emitting Diode
M	
MC	Measuring chamber
MOS	Metal-Oxide Semiconductor
MSDS	Material safety data sheet
P	
PCB	Printed Circuit Board
Q	
QC	Quality control
R	
REF	Reference solution
S	
SBC board	Mainboard of the instrument
SW	Software
T	
TTL	Transisitor-Transistor Logic

System Description A

1 Safety information A-3
2 Specifications A-11
3 Interface specifications A-17
4 Description of modules A-21
5 Electronic diagrams A-37

Safety information

In this chapter *Chapter* 1

Important information A-5
Operating safety information A-6
Important notes and warnings A-6
Disinfectants A-7
Deproteinizer A-7
Other disinfectants A-7
ESD protection measures A-8
Explanation of the phenomenon A-8
Influence of electrostatic charges on components A-8
Why is ESD protection so important today? A-8
How can ESD protection be guaranteed? A-9
Conclusion A-9

Table of contents

Important information

This Service Manual contains vital warning and safety information.

This instruments are intended to be used only for the specialized purpose described in the instructions. The most important prerequisites for use, operation, and safety are explained to ensure smooth operation. No warranty or liability claims will be covered if the instrument is used in ways other than those described or if the necessary prerequisites and safety measures are not observed.

The instrument may be operated only by persons whose qualifications enable them to comply with the safety measures that are necessary during operation of the instrument.

Suitable protective equipment, like laboratory clothing, protective gloves, protective goggles and if necessary mouth protectors, must be worn to prevent direct contact with biological working materials. In addition, a face mask is required if there is a risk.

Adjustments and maintenance performed with removed covers and connected power may be attempted only by a qualified technician who is aware of the associated dangers.

Instrument repairs are to be performed only by the manufacturer or qualified service personnel.

Only accessories and supplies either delivered by or approved by Roche are to be used with the instrument. These items are manufactured especially for use with this instrument and meet the highest quality requirements.

Operation of the instrument with solutions whose composition is not consistent with that of the original solutions can negatively affect, above all, the long term measurement accuracy. Deviations in the composition of the solutions can also decrease the service life of the electrodes.

The quality control requirements must be completed at least once daily for safety reasons. Because accurate measurement results depend not only on the proper functioning of the instrument, but also on a number of other factors (such as preanalytics), the results produced by the instrument should be examined by a trained expert before subsequent decisions are reached that are based on the measurement values.

Explanation:

"Caution, refer to accompanying documents“

Operating safety information

The instrument has been constructed and tested according to the following European Standards:

- IEC/EN 61010-1:2001
- IEC/EN 61010-2-101:2002 (valid for 9180 Electrolyte Analyzers SN > 12001 only)
- IEC/EN 61010-2-081:2002 + A1:2003

It was delivered from the factory in flawless condition with regards to safety features.

In order to preserve this condition and ensure safe operation, the user must respect the notices and warnings that are contained in this Service Manual

- This instrument is classified under the protection class I according to IEC/EN 61010-1.
- The instrument meets the conditions for overvoltage category II.
- The instrument meets the conditions for contamination level 2.
- Do not operate the instrument in an explosive environment or in the vicinity of explosive anesthetic mixtures containing oxygen or nitrous oxide.
- If an object or liquid enters the internal areas of the instrument, remove the instrument from its power supply and allow an expert to check it thoroughly before using it again.
- The instrument is suitable for long-term operation indoors.

- *The power cord may be plugged into a grounded socket only. When using an extension cord, make sure it is properly grounded.*
- *Any rupture of the ground lead inside or outside the instrument or a loose ground connection may result in hazardous operating conditions. Intentional disconnection of the grounding is not permitted.*
- *The instrument is not suitable for operation with a direct current power supply. Use only the original mains plug delivered with the instrument.*

Important notes and warnings

- *Never operate the analyzer in the vicinity of volatile or explosive gases (e.g. anesthetic gases, etc.)!*
- *The instrument must be connected to a 2-pin, grounded socket.*
- *The power cable and the plug must be undamaged. Damaged power cables and plugs must be replaced immediately.*
- *Before opening the back panel switch off the instrument and disconnect the power cable.*
- *Replace damaged fuses with the specified type of fuse.*

- *Service and repair work must be done only as specified in this manual. Unqualified service or repair work may result in warranty claims not being granted.*
- *Use only suitable tools and test instruments for service and repair work.*
- *Do not allow fluids to enter the interior of the instrument, because this may damage the electronics.*
- *Use only slightly moistened cloths or cotton sticks to clean the instrument.*

Disinfectants

Use only liquid disinfectant such as protein remover (Roche deproteinizer) or an alcohol-based (about 70%) surface disinfectant.

Do not spray disinfectant directly onto the instrument because this could cause malfunctions in the electronics.

Do not use any type of bleaching agent. Exception: Roche Deproteinizer.

Do not attempt to clean/decontaminate any part of the instrument before shutting it down and unplugging it from the power source.

Before plugging in the instrument again and switching it on always wait for 15 minutes to allow the disinfectant to evaporate.

Deproteinizer

Composition Aqueous NaOCl solution with active chlorine (≤ 2%)

Hazards identification Due to the basic and oxidizing character of the reagent ("Deproteinizer") local irritations after contact with eyes, skin or mucous membranes cannot be excluded.

First aid measures

After inhalation:	breath fresh air, drink large amounts of water
After skin contact:	wash with generous amounts of water, remove contaminated clothing
After eye contact:	rinse eyes with generous amounts of water, contact an eye specialist
After drinking:	drink large amounts of water, avoid vomiting, contact a doctor

Other disinfectants

Use standard alcohol-based (70%) disinfectants to clean the surface of the instrument. Read the product information first.

Never use standard disinfectant to clean the tubes and tubing paths under any circumstances!

Do not use any type of bleaching agent. Exception: Roche Deproteinizer.

ESD protection measures

ESD = Electrostatic Sensitive Device

Explanation of the phenomenon

The most frequent cause of electrostatic discharge is friction of various materials such as plastic, synthetic fiber, hard rubber or paper.

It can also be caused by bending or applying pressure to a material.

Discharges that are dangerous to components occur when "charged" bodies or components do not have a discharge connection (ground) to discharge the electrostatic charge.

The discharges normally do not have a high capacity, but there are often voltage differences in the range of several thousand volts. The discharges are perceived as small shocks or visible sparks.

Examples:

- Shoes with rubber soles:

  Friction is caused by walking. A person develops an electrical charge different from the ground. A discharge occurs when an object (e.g. door handle) is contacted.

- Synthetic fiber clothing:

  Discharge is audible and is visible in darkness.

The dryer the air the greater the risk of electrical discharge caused by friction.

Electrostatic charges are less likely to build up in humid air, particularly when saturated with water vapor.

The probability of ESD phenomena is therefore particularly great in a northern hemisphere winter in centrally heated rooms where the humidity is low.

Influence of electrostatic charges on components

If a person with an electrostatic charge touches a component, a discharge over a connection of an IC or semiconductor element may occur. The resulting voltages may damage the component.

Critical situations can occur while repairing or testing components if they are lying on a more or less conductive surface (e.g. table top) and a person with an electrostatic charge touches them. A discharge through a critical component connection can also occur in this case.

Why is ESD protection so important today?

Formerly, current controlling semiconductors were mostly used (TTL, normal transistors, etc.).

Today the principle of current logic is virtually the only technology in use in MOS and CMOS components.

Currents generated by an electrostatic discharge (as much as several kV!) destroy the sensitive component inputs or cause hidden damage. This damage is generally not immediately detectable.

Another effect is that the clearances inside the ICs continuously become smaller. The internal wires become thinner and thinner, the allowable maximum input voltages become smaller and the effects of any discharges become more and more critical.

How can ESD protection be guaranteed?

A continuous discharge is required when working on an electronic assembly. Do this as follows:

- Use ESD wrist bands (special wrist bands connected to a protective ground).
- Repairs and tests on assemblies must only be conducted on tables with ESD mats connected to grounds or ESD wrist bands.
- Always pick up components at the edge (e.g. like a photo).
- Components must always be transported in ESD packages or appropriate storage or shipping containers (use original packaging!).
- Shoes with rubber soles or clothing of synthetic fibers must not be worn in workshops where electronic components are repaired.
- Use a humidifier if necessary to maintain optimum humidity in the work area.
- Do not touch assemblies or components with the hand after testing.
- Always transport and ship assemblies or components for repair in ESD protective packaging only. This will prevent further damage that may result in misinterpretation of the original cause of the fault.

The ESD mat consists of materials that have a very low, defined conductivity (1012 ohms). The following materials prevent charges caused by friction from building up and protect the component from damage.

- *ESD mats*
- *ESD packages*
- *Shipping containers*

Conclusion

Of course, not all circuit boards and electronic assemblies require such careful handling. An electrical board that only carries simple plug connectors does not require ESD packaging.

In cases of doubt always use ESD packaging.

Specifications

In this chapter *Chapter* 2

Specifications A-13
Specifications A-13
9110 ..... A-13
9120/9130/9140/9180/9181 ..... A-13
Operating Parameters A-13
9110 ..... A-13
9120/9130/9140/9180/9181 ..... A-14
Common operating parameter A-14
Classifications A-15
Product data A-15
Approvals A-15

Table of contents

Specifications

Specifications

9110

Sample types Whole blood, Serum, Plasma, QC solutions

Reported parameters	Measuring range	Resolution
pH	6.00 - 8.00	0.001 pH units

Table A-1 9110 reported parameters

9120/9130/9140/9180/9181

Sample types Whole blood, Serum, Plasma

Reported parameters	Measuring range	Resolution
Sodium (Na^+)	40 - 205 mmol/L	0.1 mmol/L
Potassium (K^+)	1.5 - 15 mmol/L	0.01 mmol/L
	(0.8 - 15 mmol/L dialysate)	
Chloride (Cl^-)	50 - 200 mmol/L	0.1 mmol/L
Calcium (Ca^{2+})	0.2 - 5.0 mmol/L	0.01 mmol/L
Lithium (Li^+)	0.1 - 6.0 mmol/L	0.001 mmol/L

Table A-2 9120, 9130, 9140, 9180, 9181 reported parameters (1)

Sample type Urine

Reported parameters	Measuring range	Resolution
Sodium (Na^+)	1 - 300 mmol/L	1.0 mmol/L
Potassium (K^+)	4.5 - 120 mmol/L	0.1 mmol/L
	(60 - 120 mmol/L with add. dilution)	
Chloride (Cl^-)	1 - 300 mmol/L	1.0 mmol/L

Table A-3 9120, 9130, 9140, 9180, 9181 reported parameters (2)

Calcium and Lithium are not measured in urine samples.
Lithium is not measured in dialysate samples.

Operating Parameters

9110

Sample types Whole blood, serum, plasma, aqueous and QC solutions

Sample device Syringe, sample cup, capillary, Roche *MICROSAMPLER*

Sample size	25 µL
Analysis time	70 seconds
Sample rate	• 40 per hour with printout • 50 per hour without printout
pH Sensor	pH sensitive flow-through glass capillary electrode in transparent acrylic plastic
Reference System	Open liquid junction, flow-through electrode
Calibration	• Fully automatic • 1 point with each sample • 2 point every 3 hours
Warm-up time	10 minutes

9120/9130/9140/9180/9181

Sample types	Whole blood, serum, plasma, urine, dialysate (acetate or bicarbonate)
Sample device	Syringe, sample cup, capillary, Roche *MICROSAMPLER*
Sample size	95 µL
Analysis time	50 seconds
Sample rate	• 45 per hour with printout • 60 per hour without printout
Sodium (Na^+) sensor	Ion-selective, flow-through, glass capillary electrode
Potassium (K^+) sensor	Ion-selective, flow-through, liquide membrane electrode
Chloride (Cl^-) sensor	Ion-selective, flow-through, liquide membrane electrode
Calcium (Ca^{2+}) sensor	Ion-selective, flow-through, liquide membrane electrode
Lithium (Li^+) sensor	Ion-selective, flow-through, liquide membrane electrode
Reference system	Open liquid junction, flow-through electrode
Calibration	• Fully automatic • 1 point with each sample • 2 point every 3 hours (9180/9181 every 4 hours)
Warm-up time	10 minutes

Common operating parameter

Standby mode	Suspends calibrations
Temperature	Room temperature, 15 - 32°C, 60 - 90 °F

Humidity	maximum 85 % relative humidity, non-condensing
Data management	Quality control memory storage, 3 levels, 35 values; calculation of mean, standard deviation and coefficien of variation (CV)
Diganostic programs	user-controlled diagnostics, YES/NO operation via the display
Electronics	Microprocessor-controlled
Display	LCD dot-matrix, 2 lines, 16 characters per line
Printer	Integral thermal printer, 16 characters width
Autosampler (9181 only)	Integral turntable, 18 positions, 2 mL or 0.25 mL sample cups
Interface	RS232C serial port
DataLink	Data link to COMAPCT 2/3 (9180/9181)
Electrical requirements	100 - 240 VAC, 50/60 Hz (90 - 250 VAC for 9110), self adjusting
Nominal power consumption	50 W

Dimensions

Height	335 mm (12.2")
Width	315 mm (12.4")
Depth	295 mm (12.0")
Weight	approx. 6 kg (13 lbs)

Table A-4 Instrument dimensions

Classifications

Product data

Safety category	I
Device type	B (according to ÖVE-MG/EN 60601-1, IEC 601-1)
Mode of operation	continuous operation
Protection classification	IP 20
Explosion protection	the device is not designed for operation in explosive environments.

Approvals

CSA, CE, FCC Class B

CLIA Complexity Category: Moderate

Test System Code: 04739

FDA 510(k) numbers:	K932642 (9110)
	K961458 (9180)
	K972673 (9181)
Analyte Codes:	Na^+: 5805
	K^+: 4910
	Cl^-: 1018
	Ca^{2+}: 1004
	Li^+: 3712
Special requirements for IVD products	EN 61010-2: 2001-12
	EN 61010-2: 2002-01
	(9180 SN > 12001 only)

Data subject to change without notice. Technical information is supplied for general informational purposes only!

Interface specifications

In this chapter *Chapter* 3

Interface specifications A-19
Interface information A-19
Software A-19
Example data string information A-20
Automatic Calibration Report A-20
Serum sample report A-20
Data Link Information (9180/9181 only) A-20

Table of contents

Interface specifications

Interface information

The 9110, 9120, 9130, 9140, 9180 and 9181 analyzers are equipped with a standard serial interface output. This interface output is intended to be used with standard commercially available computer systems.

The data transmitted through the serial interface port employs the ASCII code.

The serial interface is terminated on the rear cover with a 9-pin male DB-9 connector.

The signal levels are as follows:

- Binary 1 = -12 V to -3 V
- Binary 0 = +3 V to +12 V

Two stop bits follow the eight data bits to complete the 10 bit word.

The baud rate is set at 9600 Baud fixed.

The maximal recommended cable length is 40 feet.

The pin assignment is as follows:

- pin 1...sample ground...GND
- pin 2...receive data....RxD
- pin 3...send data.....TxD
- pin 4...NC
- pin 5...signal ground...GND
- pin 6...NC
- pin 7...RTS (not used)
- pin 8...CTS(not used)
- pin 9...NC

  (NC=Not Connected)

Higher discharge current

A higher discharge current can be expected when using the serial interface. This must be checked by suitably qualified personnel, depending on the local regulations.

Software

The patient sample data is sent at the end of each measurement, the calibration report is sent at the end of each calibration.

The interface is always on, independent of the printer settings; the data is always sent.

Note

The arrow up (e.g. out of normal range) is sent as HEX 18 (↑), the arrow down as HEX19 (↓) and the ° (degree) is sent as HEX1A (→).

Example data string information

Automatic Calibration Report

```
<sx>* AVL 9130*<cr><crlf>ELECTROLYTE ISE<cr><crlf> 03JAN92
10:51crcrlf*CALIBR REPORT*<cr><crlf><cr><crlf>
DailyMaintenance<cr><crlf>Performed Last: <cr><crlf> 02JAN92 10:35
<cr><crlf><cr><crlf> Standard A<cr><crlf>Na = -112mV (3)<cr><crlf>
K = -1392mV (3)<cr><crlf>Cl = -106mV (3)<cr><crlf><cr><crlf>
Difference A-B<cr><crlf>Na = 1402mV ( )<cr><crlf>K = 1032mV ( )
<cr><crlf>Cl = -1006mV ( ) <cr><crlf><cr><crlf>Fluid Pack:<cr><crlf>
68% Remaining<cr><crlf><cr><crlf><ex>
```

Serum sample report

```
<sx>* AVL 9130*<cr><crlf>ELECTROLYTE ISE<cr><crlf> 03JAN92
10:59<cr><crlf><cr><crlf> Name: ..........<cr><crlf> ..........
<cr><crlf>Sample: SERUM<cr><crlf><cr><crlf> Sample No.13
<cr><crlf><cr><crlf>Na= 159soh mmol/L<cr><crlf>K = 5.4 mmol/L
<cr><crlf>Cl= 122soh mmol/L<cr><crlf><cr><crlf>*PERFORM DAILY *
<cr><crlf>*MAINTENANCE ! *<cr><crlf><cr><crlf><ex>
```

Data Link Information (9180/9181 only)

The data link with the COMPACT 2/3 blood gas analyzer allows to combine ISE results with pH/blood gas results on one printout. If Ca^{2+} is activated on the 9180/9181, a pH-corrected Ca^{2+} value will be calculated and printed on the combined sample report.

For connection of the 9180/9181 analyzer to the COMPACT 2/3 analyzer, the optional Interface Kit is required. To install the kit, first turn both instruments off. Connect the interface filter provided in the kit to the RS232 port on the 9180/9181. Then connect one end of the cable to the interface filter, the other end to the **COM 2** port on the COMPACT 2/3. On the COMPACT 2/3, select *9180* under the **COM 2** interface options.

See COMPACT 2/3 Operator's Manual for details.

Description of modules

Insert introducing text here.

In this chapter *Chapter* 4

Description of modules A-23
Mechanical assemblies A-23
Front door assembly A-23
Needle unit assembly A-23
Electrode holder assembly A-24
Peristaltic pump assembly A-24
Solenoid assembly A-25
Printer assembly A-25
Rear panel assembly A-25
SBC board A-26
Lamp board A-27
Display board A-27
Fluidic Module A-27
Standard A A-27
Standard B A-27
Standard C (not on 9110) A-27
Cleaning solution (9110 only) A-28
Reference solution A-28
Waste liquids A-28
Main tube set (all models)/ Intake tube set (9110 only) A-28
Sample Contacts (9110 only) A-29
Electronics A-33
ISE SBC card A-33
Lamp board A-34
Display board A-35

Table of contents

Description of modules

After changing any part of the analyzer always perform a calibration of the analyzer as well as a full QC measurement. QC measurements must be performed in their entirety (i.e., all three QC levels must be measured). Omitting QC measurements or ignoring QC measurement results may lead to incorrect patient measurements, which may result in incorrect clinical decisions, possibly endangering the patient's health.

Mechanical assemblies

Front door assembly

For the 9110, 20, 30, 40 and 80 analyzers, the front door can be removed by moving the analyzer to the edge of a work surface so the analyzer door, when opened, will extend past the edge of the work surface. With one hand, hold the analyzer door near the right side hinge pin and, with the other hand, gently apply pressure to the middle rear area of the door. This will allow the right hinge pin to clear the retaining hole in the main chassis. The door can then be removed from the analyzer.

The 9181 front panel can be removed by tilting it slightly away from the analyzer and lifting it straight up. The plastic window can also be replaced in the field by gently pressing from the rear of the window and snapping the plastic window out toward the front of the analyzer door. The door magnets cannot be replaced in the field as they are glued in place with conductive adhesive.

Due to the update of the 9180 Electrolyte Analyzer according to IVDD compliance a new shielded front door "FRONT DOOR 9180" is available and compatible with any 9180 Electrolyte Analyzer (old type SN < 11999 and new type SN > 12001) and with 9120, 30, 40 Electrolyte Analyzers.

Further information: see the 91xx Spare Parts List.

See the *91xx Spare Parts List* for a detailed reference of the parts of this assembly.

Needle unit assembly

To remove the 9110 fill port for replacement or cleaning, grasp the white tab on the fill port and rotate the bayonet-style connector counter-clockwise. Gently pull the fill port forward to remove. Replacement can be accomplished in the reverse order. During removal, be careful not to bend the needle.

The 9110 fill port assembly is desinged for easy removal without the use of tools, for cleaning, changing tubing or replacement. First, disconnect the sample intake tube on the left side of the fill port assembly from the sample preheater. Grasp the fill port assembly and pull it forward carefully. Disconnect the wire from the needle arm. To reassemble, reconnect the wire, press the fill port assembly into place and reconnect the tubing.

The 9110 wash port located on the underside of the flap can be removed by appying pressure to one side to overcome the snap fit. To reinsert, align wash port and apply pressure to snap into place.

The 9120, 30, 40, 80 and 81 sample needle and fill port are both designed for easy replacement by the user. To remove the fill port assembly for replacement, pull the fill

port holder towards the front for easy access. Then, press the two plastic tabs on the fill port to allow removal of the fill port from the fill port holder. The sample needle can also be removed and is supplied as a one-piece assembly including the intake tubing.

To remove the 9120, 30, 40, 80 and 81 sample needle, grasp the needle near the white holder block and pull up to unsnap the sample needle from its position. To replace the assembly, align a replacement sample needle and press the replacement assembly into place.

Two (9110) or three screws (9120, 30, 40, 80, 81) located on the left side of the assembly hold the needle unit assembly in place. To access the two rear screws, turn power off and remove the rear panel. The rear panel can be moved away from the unit for easier access by unplugging the wire harness from the power supply. The SBC board can now be removed by removing the screws which secure the SBC board and disconnecting the cables on the SBC board.

Disconnect the connector to the lamp board which supplies the Door Open signal. The two rear screws which secure the needle unit can now be removed using a Philips screwdriver (9110) or an Allen wrench (9120, 30, 40, 80, 81). Then, remove the front securing screw (n./a. on the 9110), the sample intake tubing and the reagent supply tubing (red tag) from the fill port. The needle unit can now be removed from the front of the analyzer for replacement.

👁 See the *91xx Spare Parts List* for a detailed reference of the parts of the needle unit.

Electrode holder assembly

To remove the electrode holder assembly from the analyzer, first unplug the sample intake tubing on the right side of the module, then the preheater cable (9110 only) or the sample sensor cable (9120, 30, 40, 80 and 81), then remove the reference solution tubing connector and last, take out the waste tube (green tag) at the left side of the electrode holder. The electrode holder can now be removed by pressing the two plastic tabs (right and left side of the module) and sliding the module forward. Press the plastic tabs again to release the second detent and completely remove the module from the analyzer. The sample preheater or the sample sensor and/or the left side electrode holder can be removed and replaced by removing the screws on the under side of this module.

👁 See the *91xx Spare Parts List* for a detailed reference of the parts of this assembly.

Peristaltic pump assembly

Replacement of the roller assembly of the peristaltic pump can be accomplished by removing the pump tubing and firmly pulling the roller assembly toward the front. To replace the roller assembly, align the roller and the flat on the motor shaft and press the replacement roller into position.

To remove the motor, first remove the rear panel assembly and SBC Board.

👁 For details, see *Rear panel assembly* on page A-25, *SBC board* on page A-26.

Now, the electrical connector on the lamp board can be accessed to unplug the motor connector. The motor can now be removed by removing four screws located on the front of the housing near the peristaltic pump.

Solenoid assembly

Removal of each solenoid is identical. Each solenoid valve has a removable pressure piece which is held in place by a solenoid cap. To remove the pressure piece, locate the arrow on the solenoid cap and remove the solenoid cap by sliding it off the solenoid shaft in the direction of the arrow. This exposes the pressure piece which can now be removed from the solenoid shaft. To replace pressure piece and cap, energize the solenoid as described in *TEST PINCH VALVES* on page B-67. This extends the solenoid shaft to the outermost position for ease in replacing pressure piece and cap. Removal of the pressure piece and cap is required prior to removing the solenoid and allows for easier replacement of the tubing under each solenoid.

To remove the solenoid assembly, the rear panel and the SBC Board (described in *Rear panel assembly* on page A-25 and *SBC board* on page A-26) must be removed first.

For details, see *Rear panel assembly* on page A-25, *SBC board* on page A-26.

Each solenoid has an electrical connection to the lamp board which must be unplugged prior to removal of the solenoid. At this point, remove the two screws on the front panel to remove the solenoid assembly.

Note

The 9110 R-solenoid incorporates two heat sinks and is not interchangeable with the other solenoids.

Printer assembly

The printer assembly is designed to allow for easy removal by the user which can be accomplished without removal of the electrical power to the analyzer. Slide the paper tray forward to allow access to the printer, tear the paper roll and completely remove it together with the paper tray. Slide fingers under the printer assembly and pull the printer forward. This will disengage the printer from the interconnector and enable removal of the assembly from the front of the analyzer. Removal of the printer should be performed for replacement and for removal of a paper jam.

To replace the printer, locate the printer slide and insert the printer assembly. Press firmly into place to ensure electrical connection of the printer.

Note

Never attempt to dislodge paper from the printer with a paper clip or similar object to avoid damage to the print head or printer platen.

Due to the update of the 9180 Electrolyte Analyzer according to IVDD compliance a new printer assembly "PRINTER MODULE, ISE" is available and compatible with 9110 pH Analyzers and with any 9120, 30, 40, 80 and 81 Electrolyte Analyzer.

Further information: see the 91xx Spare Parts List.

Rear panel assembly

To remove the rear panel assembly, ensure that the power cord has been disconnected from the analyzer. Remove the four corner screws to expose the rear panel. The power supply module located on the rear panel assembly can now be removed by removing the three screws securing the circuit board and by disconnecting the wiring

interconnections. The main power receptacle can also be replaced by removing the two screws holding this assembly.

Due to the update of the 9180 Electrolyte Analyzer according to IVDD compliance a new power supply module "POWER SUPPLY 9180 >SN 12001" is available and compatible with 9180 Electrolyte Analyzers serial number > 12001 only.

The former power supply "MODULE POWER SUPPLY, ISE" is still available and has to be used for 9180 Electrolyte Analyzers SN < 11999, for 9110 pH Analyzers and for 9120, 30, 40 and 81 Electrolyte Analyzers.

Further information: see the 91xx Spare Parts List.

After changing the main board or the power supply always perform a measurement of protective ground resistance to ensure a safe connection of the system ground. Always measure with the power cord attached to the analyzer. The resistance measurement has to be done between the ground pin of the power plug and several ground connectors placed on each of the analyzer's electronic components such as power supply or main board and shielding. The total resistance should not exceed 0.5 ohms. Be sure to consider the resistance of the ohmmeter's connecting cables.

SBC board

After the rear panel has been removed, the SBC Board is accessible for removal. This circuit board can be removed by removing the seven screws securing the board to the housing and by disconnecting electrical connectors from the power supply module, display board and lamp board.

For details, see *Rear panel assembly* on page A-25.

The electrode push pins can now be replaced by simply pulling the connecting pin from its socket. When installing the board, make sure to place the plastic washers under the screw heads.

Due to the update of the 9180 Electrolyte Analyzer according to IVDD compliance a new SBC board "MAINBOARD 9180 >SN 12001" is available and compatible with 9180 Electrolyte Analyzers serial number > 12001 only. The former SBC board "MAINBOARD 9180 <SN 11999" is still available and has to be used for 9180 Electrolyte Analyzers SN < 11999.

Further information: see the 91xx Spare Parts List.

After changing the main board or the power supply always perform a measurement of protective ground resistance to ensure a safe connection of the system ground. Always measure with the power cord attached to the analyzer. The resistance measurement has to be done between the ground pin of the power plug and several ground connectors placed on each of the analyzer's electronic components such as power supply or main board and shielding. The total resistance should not exceed 0.5 ohms. Be sure to consider the resistance of the ohmmeter's connecting cables.

Note

Due to the update of the 9180 Electrolyte Analyzer according to IVDD compliance the printouts, display messages and data links sequences of the 9180 Electrolyte Analyzers serial number > 12001 will show "Roche" instead of "AVL". This also applies to 9180 Electrolyte Analyzers serial number < 11999 in case of replacing the main board "MAINBOARD 9180 >SN 12001" or the program set "PROGRAM SET 9180".

Lamp board

The rear panel and SBC board must be removed to gain access to the lamp board. Remove one screw and washer which hold the board in place and remove the electrical connectors to remove this board.

Display board

The rear panel and SBC board must be removed to gain access to the display board. Remove three screws and 50 degree spacers and unplug the preheater or sample sensor cable from the front and the ribbon cable to the SBC board to remove the display board.

Fluidic Module

Standard A

Standard A is drawn to the electrode module by vacuum provided by the peristaltic pump.

9110 pH Analyzers: When Standard A is to be aspirated into the electrode module, solenoid valve A and R are opened. Standard A is then drawn from the ISE SnapPak^{TM} until Sample Contact 1 detects Standard A bridging the T-piece and Sample Contact 1. At this point, solenoid valve V is opened and solenoid valve A is closed. The standard is pumped up the tubing, through the wash portand into the sample needle until Sample Contact 2 detects the standard. The peristaltic pump slows down and the standard moves into the electrode module until detected by Sample Contact 3 (bridge between sample preheater tube and reference electrode). Then, the pump stops.

9120, 30, 40, 80, 81 Electrolyte Analyzers: When Standard A is to be aspirated into the electrode module, solenoid valve A is opened and solenoid valves B, V and R are closed. Standard A is then drawn from the ISE SnapPak^{TM}, to the fill port, through the sample needle and is sensed by the sample sensor. At this point, solenoid valve V is opened and solenoid valve A is closed as the peristaltic pump continues to pump Standard A into the electrode module. As the trailing edge of the Standard A sample is sensed by the sample sensor, the peristaltic pump stops.

During the time Standard A is aspirated into the electrode module, the reference housing is pressurized due to the peristaltic pump providing pressure to the reference solution line and solenoid valve R being closed. An amount of reference solution is forced out through the reference junction to provide contact to the sample.

Standard B

The process for Standard B is identical to that of Standard A with the exception of the operation of solenoid valve B. This solenoid valve is operated in reverse order of Standard A aspiration.

Standard C (not on 9110)

The process for Standard C is identical to that of Standard A with the exception of the operation of solenoid valve C. This solenoid valve is operated in reverse order of Standard A aspiration.

Cleaning solution (9110 only)

The cleaning routine within the 9110 pH Analyzer is automatic with cleaning solution being aspirated through the system every 40th sample or every 24 hours. Automatic operator-initiated cleaning can also be performed, by selecting **ELECTRODE CLEANING** from the main menu. The cleaning routine is very similar to the aspiration of Standard A or B with solenoid valve C being opened to allow cleaning solution to be aspirated through the fluidic path. The timing of the cleaning solution routine allows for a larger volume of cleaning solution to be aspirated than the Standard A or B cycles to ensure that cleaning solution covers the electrodes, wash port, fill port, sample needle and preheater during the cleaning cycle.

Reference solution

The reference housing is filled automatically using the second winding of the peristaltic pump and solenoid valve R. The reference solution connector allows for the reference housing tubing to be plugged into the reference solution circuit. As the peristaltic pump aspirates reference solution, solenoid valve R is opened to allow excess solution to be pumped into the reference return line of the ISE SnapPak^{TM}.

A check valve is placed in the return line to ensure that the KCl output is constant (9110 only).

Waste liquids

Calibration standard and sample waste are pumped out of the left side of the electrode module (green-banded tubing) through the peristaltic pump to the waste line of the ISE SnapPak^{TM}. An internal one-way valve is incorporated into the waste line of each ISE SnapPak^{TM} to prevent any waste products from leaking out of the ISE SnapPak^{TM}.

Main tube set (all models)/ Intake tube set (9110 only)

The main tube set is supplied as a pre-cut tubing harness with the fluidic interconnections preassembled. Replacement of the tube set should be performed annually. For removal of the tubing, first remove the ISE SnapPak^{TM} from the reagent compartment. This will allow access for removal of the white TPR block which is the main interconnection between the ISE SnapPak^{TM} and the tubing. This block can be removed by grasping the front surface and pulling forward. Next, remove tubing from each solenoid valve. Follow the procedure outlined in Section 4.1.5 for disassembly of the solenoid valves to enable fluidic tubing to be easily removed at each solenoid.

👁 For details, see *Rear panel assembly* on page A-25, *SBC board* on page A-26.

Pull the two pump windings at the peristaltic pump tube set off the pump roller and remove the white reference solution tube connector. Remove the white TPR reference solution block by grasping the front of the block and pulling forward. The three tube connections are labeled with green, blue and red tags. All remaining tubes can now be removed and the entire tubing harness can be discarded.

Fit the replacement tubing harness and assemble in reverse order as disassembly. Reference the Tube Diagram on the next page for correct tube locations.

Intake Tube Set (9110 only)

The intake tube set comprises three pieces of tubing. A short piece (red tag) fits between the white T-piece and the standard contact. The long piece can be positioned between the standard contact and the wash port. The remaining tube can be fitted between the sample needle and the preheater tube.

Sample Contacts (9110 only)

The 9110 fluid detection is based on the principle of measuring the impedance in a sample contact path. There are three sample contacts in the 9110 pH Analyzer. Sample Contact 1 senses standard solution draws.

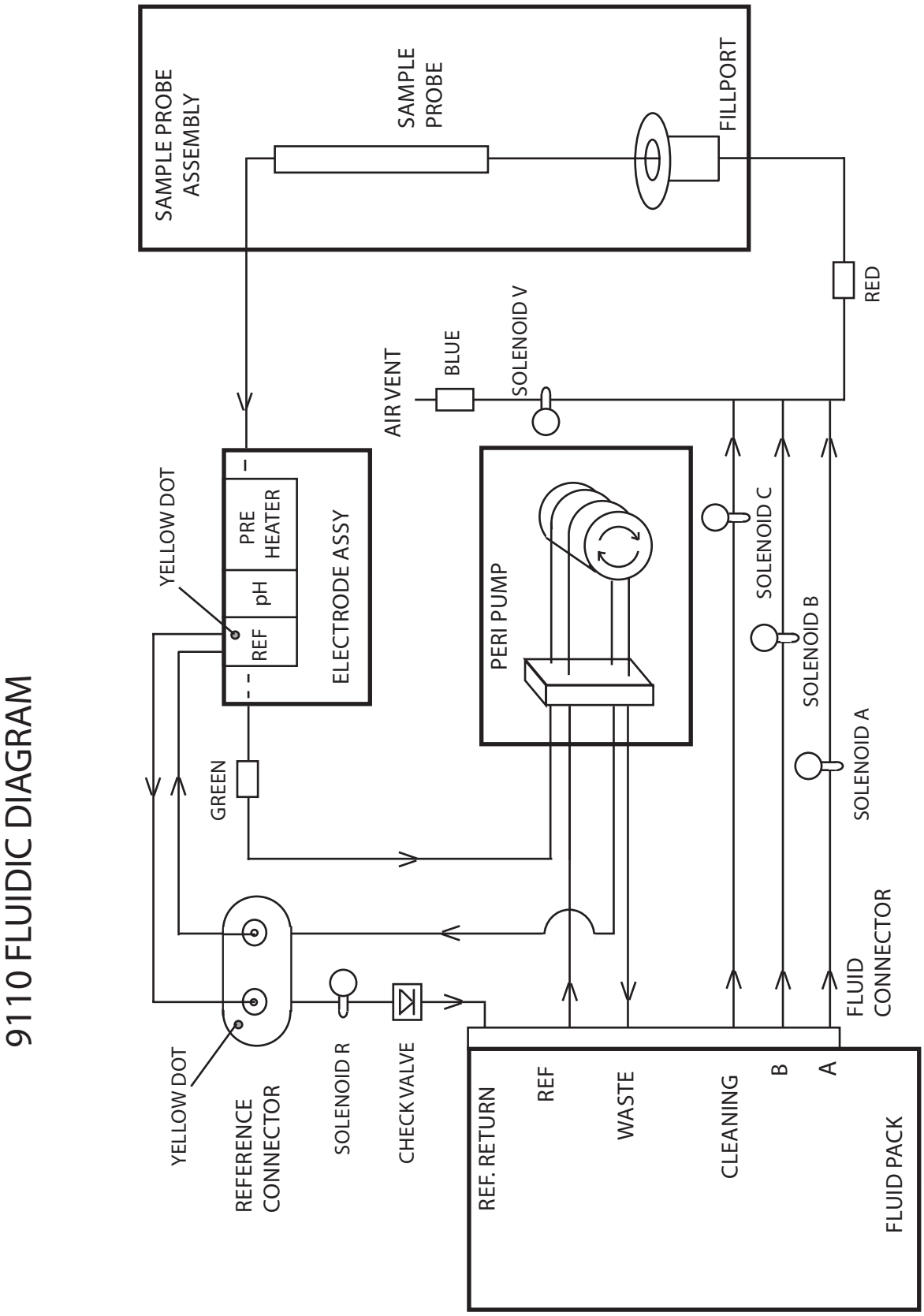


Figure A-1 9110 fluidic diagram

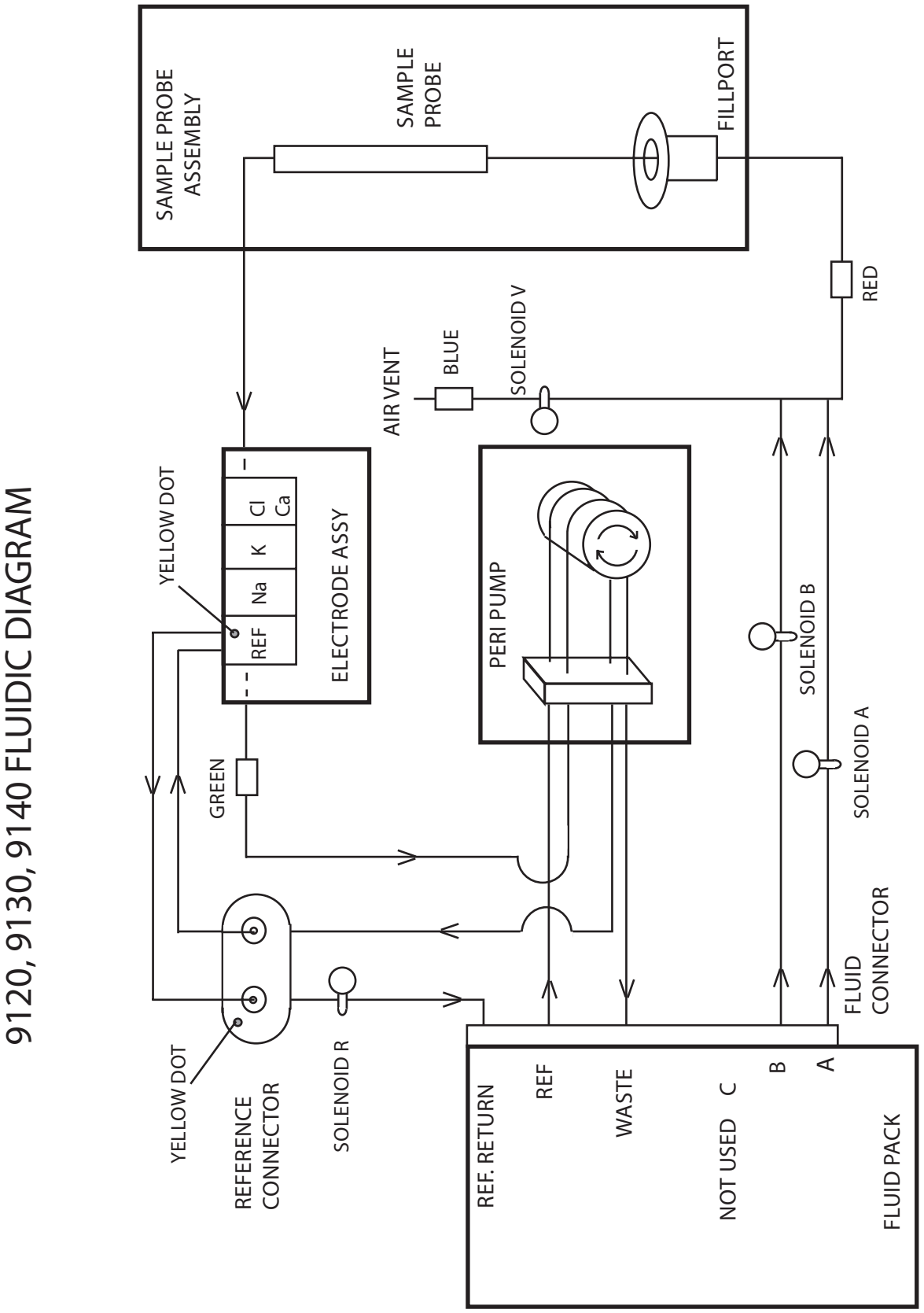


Figure A-2 9120, 9130, 9140 fluidic diagram

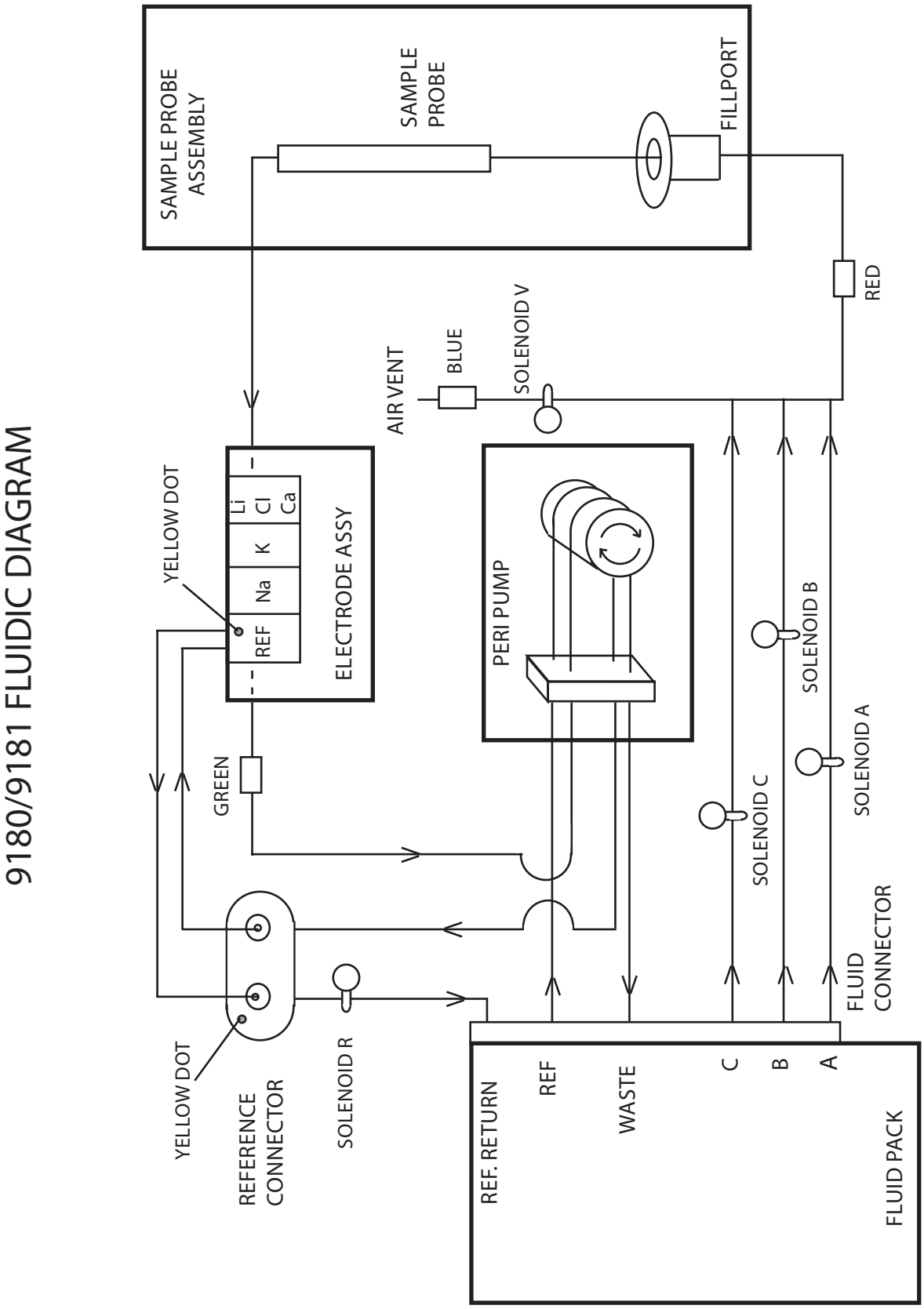


Figure A-3 9180, 9181 fluidic diagram

Electronics

ISE SBC card

Power circuits

Power is supplied to this circuit board through connector JP3 from the power supply assembly. Test points are provided to measure supply voltages, and light emitting diodes D1 through D5 are turned on to indicate each supply voltage present on the card. Since each LED is connected in series after the fuse, a blown fuse results in the respective LED turned off.

Four additional voltage regulator circuits are mounted on the ISE SBC II Card. IC U2 and IC U3 provide -8 VDC and +8 VDC (9180/9181: -5 VDC and +5 VDC) and are used to provide the supply voltages for the analog circuitry. IC U1 develops the supply voltage used to operate the peristaltic pump and provide either +10 VDC or +22 VDC. The +22 VDC is supplied only for the FAST speed and +10 VDC is used for all other pump speeds. Signal FAST/SLOW determines which supply voltage is selected.

U5 switches the voltage between 22 VDC and 12.5 VDC (16 VDC on the 9110) which supplies the solenoids. When a solenoid is turned on, the voltage switches to 22 VDC for 0.5 sec, then it returns to 12.5 VDC (16 VDC on the 9110).

The circuit which includes Q7 and R5 provides necessary switching for the measuring chamber illuminator LEDs.

The following list identifies the test points, fuses and LEDs for each respective DC supply voltage:

Test point	Voltage	Fuse	Rating	LED
TP1	+24 VDC	F3	1.25 AT	D3
TP2	+5 VDC	F1/F2	2.0 AT/1.6 AT	D1/D2
TP3	-12 VDC	F4	0.3 AT	D4
TP4	+12 VDC	F5	0.3 AT	D5
TP5	Ground			

Table A-5 Voltage test points, LEDs

Test point	Voltage
TP6	-8 VDC (9180/9181: -5 VDC)
TP7	+22/12 VDC
TP8	+8 VDC (9180/9181: +5 VDC)
TP9	Na^+ channel (pH channel on the 9110)
TP10	K^+ channel (not used on the 9110)
TP11	Ca^{2+}/Cl^- channel (Li^+ 9180/9181 only; not used on the 9110)
TP12	Temperature
TP13	+10.000 V ref. voltage
TP14	-2.500 V ref.voltage (-2.500 V on the 9110)
TP15	Sample sensor (sample contact voltage on the 9110)
TP16	+22/12.5 VDC (+22/+16 VDC on the 9110)

Table A-6 Voltage test points

Valve drivers

The solenoids are activated by transistors Q9 - Q13. To open the solenoid, a 0.5-second pulse of 22 V is applied, then the voltage drops down to 12.5 V (16 V on the 9110) to hold the solenoid open.

Pump motor driver/cover sensor

The pump driver circuit IC U9 and IC U10 provide the drive and control for the peristaltic pump. Signals PUMPEN, Pump Enable and PUMPSTEP, Pump Step Pulses enable IC U10 to provide the necessary control to driver IC U9 which supplies pump drive signals PHASE A through PHASE D to control peristaltic pump operation.

IC U11 operates with signal DCLOSED from the sample door light gate to provide signal DOOR which detects the status of the sample door (open or closed).

Input amplifiers

IC U13, U14 and U15 (9110/9180/9181: U13 only) provide high to low input impedance matching for each Electrode input. Offset generator IC U12D and amplifiers IC U12A, U12B and U12C provide the necessary gain and offset for each electrode channel. TP9, TP10 and TP11 provide test points for the Na^+ (TP9: pH on the 9110), K^+ and Cl^-/Ca^{2+}/Li^+ channels respectively.

9110 only: IC U300 is used as the input amplifier for the reference electrode, IC U12A is used for the subtraction of the reference electrode signal from the pH electrode signal. For sample detection, the reference electrode is switched to ground (relay K300) during aspiration.

Temperature sensor

This circuit is used in the 9110 pH Analyzer to amplify the signal of the temperature sensor in the preheater. This is an optional circuit which is used in the 9140, 9180 and 9181.

The circuit creates a temperature-dependent voltage which is converted by software to degrees Celsius. R54 can be adjusted for correct temperature display.

Analog channel selector and A/D converter

Analog inputs from the input amplifiers are selected via signals ADSEL0 through ADSEL2 and are multiplexed by IC U19. This multiplexed signal is then fed to the A/D Converter IC U20. IC U21 supplies the necessary reference voltage (2500mV) for the A/D Converter and can be measured at TP14.

Microprocessor

Microprocessor IC U31, EPROM IC U25 (9180/9181: U40) and MOSTEK Real Time Clock/RAM IC U22 form the components of the central processing system. IC U23 Address Demultiplexer, IC U24 Programmable Array Logic (PAL) and IC U28 provide serial data buses (9180/9181: U23, U24 and U28 not present). IC U34 through IC U38 convert serial data to parallel data and provide printer data, display data, solenoid valve control and peristaltic pump control (9110: U34 not present). This fashion of serial to parallel data conversion is used to prevent analyzer lock-up by peripheral devices. The RS232 serial interface is a direct input/output from the microprocessor utilizing interface driver and receiver U29 and U30.

SnapPak Sensor (9180/9181 only)

Optical detector ISO1 provides a signal indicating if the ISE SnapPak™ is in place. This signal is fed to U41 which converts the light gate input to a digital logic output indicating SnapPak position (IN or OUT).

Lamp board

The lamp board contains the LED array used to illuminate the measuring chamber and the interconnectors used for all solenoids, the peristaltic pump, door sensor and sample turntable (9181 only). A ribbon cable from the SBC Board supplies the electrical connection for each signal through connector JP6.

Display board

The display board contains the LCD display, sample contact circuit (9110 only) or sample sensor connector, the preheater (9110 only) and the **YES** and **NO** switches used for operation of the analyzer. Power and signal interconnection is accomplished via a ribbon cable from the SBC board through JP2 on the display board.

9110 only The sample contact circuit consists of a square wave generator U1B which generates a 500 Hz signal. U1A amplifies the signal, D2 and C3 rectify the square wave. The gain can be adjusted with R10. The sample contact output provides a DC voltage, which is proportional to the square wave amplitude. During sample aspiration, the preheater tube and the sample contact 1 tube are connected to the square wave via relay K1.

The heater control circuit controls two transistors which are placed in the preheater block. A thermistor provides temperature feedback to the setting of potentiometer R20. The signal difference drives the base of the heating transistors via buffer U2C. U2D shuts the system off in case the thermistor opens. U2B limits the maximum heating current during warm-up. U1C and attached circuit is used as an AC/DC converter to create negative voltage $-V_{SS}$, using square wave generator U1B.

9181 only Display boards utilized in the 9181 analyzer also contain circuitry for both the needle mechanism motor control and position sensor. The autosampler "Table Present" signal is also buffered through U1 on this board.

Electronic diagrams

In this chapter *Chapter* 5

Electronic diagrams A-39
9110 analyzer block diagram A-39
9120, 9130, 9140, 9180 analyzer block diagram A-40
9181 analyzer block diagram A-41
System interconnect - 9110, 9120, 9130, 9140 ..... A-42
SBC PCB - power supply - 9110, 9120, 9130, 9140 ..... A-43
SBC PCB - valve drivers - 9110, 9120, 9130, 9140 ..... A-44
SBC PCB - pump motor driver / door detect - 9110, 9120, 9130, 9140 ..... A-45
SBC PCB - input amplifiers - 9110, 9120, 9130, 9140 ..... A-46
SBC PCB - temperature circuit - 9110, 9120, 9130, 9140 ..... A-47
SBC PCB - analog selector and A/D converter - 9110, 9120, 9130, 9140 ..... A-48
SBC PCB - microprocessor - 9110, 9120, 9130, 9140 ..... A-49
SBC PCB - printer display drivers - 9110, 9120, 9130, 9140 ..... A-50
Printer daughter PCB - 9110, 9120, 9130, 9140, 9180, 9181 ..... A-51
Lamp PCB - 9110, 9120, 9130, 9140 ..... A-52
Display daughter PCB - 9110 ..... A-53
Preheater PCB - 9110 ..... A-54
Display daughter PCB - 9120, 9130, 9140 ..... A-55
System interconnect - 9180, 9181 ..... A-56
SBC PCB - power supply - 9180, 9181 ..... A-57
SBC PCB - valve drivers - 9180, 9181 ..... A-58
SBC PCB - pump motor driver/door detect - 9180, 9181 ..... A-59
SBC PCB - input amplifier - 9180, 9181 ..... A-60
SBC PCB - temperature circuit - 9180, 9181 ..... A-61
SBC PCB - analog selector and A/D converter - 9180, 9181 ..... A-62
SBC PCB - microprocessor - 9180, 9181 ..... A-63
SBC PCB - microprocessor - 9180, 9181 ..... A-64

SBC PCB - Fluid pack detector - 9180, 9181 ..... A-65
Lamp PCB - 9180, 9181 ..... A-66
Display daughter PCB - 9180 ..... A-67

Electronic diagrams

9110 analyzer block diagram

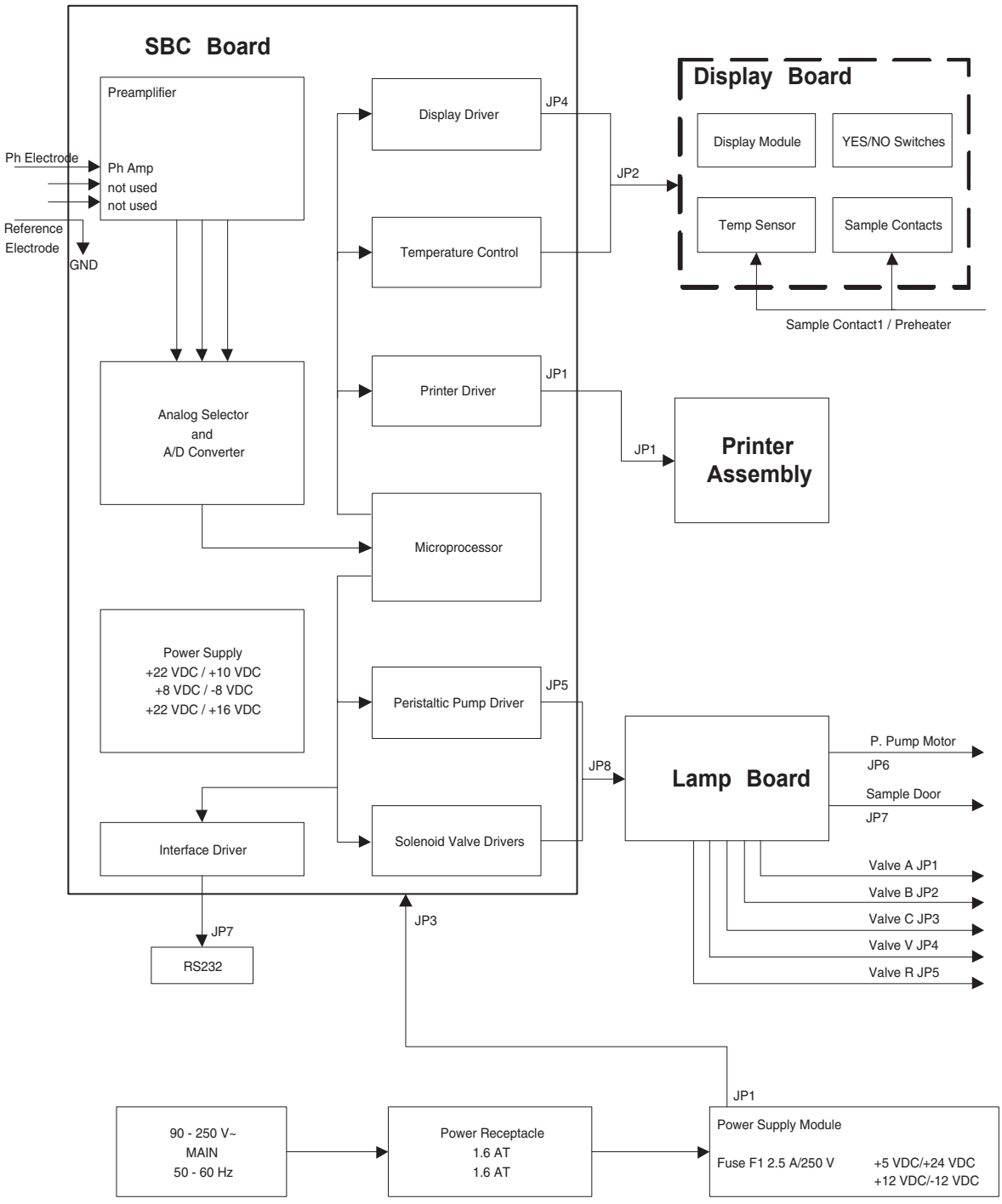


Figure A-4 9110 analyzer block diagram

9120, 9130, 9140, 9180 analyzer block diagram

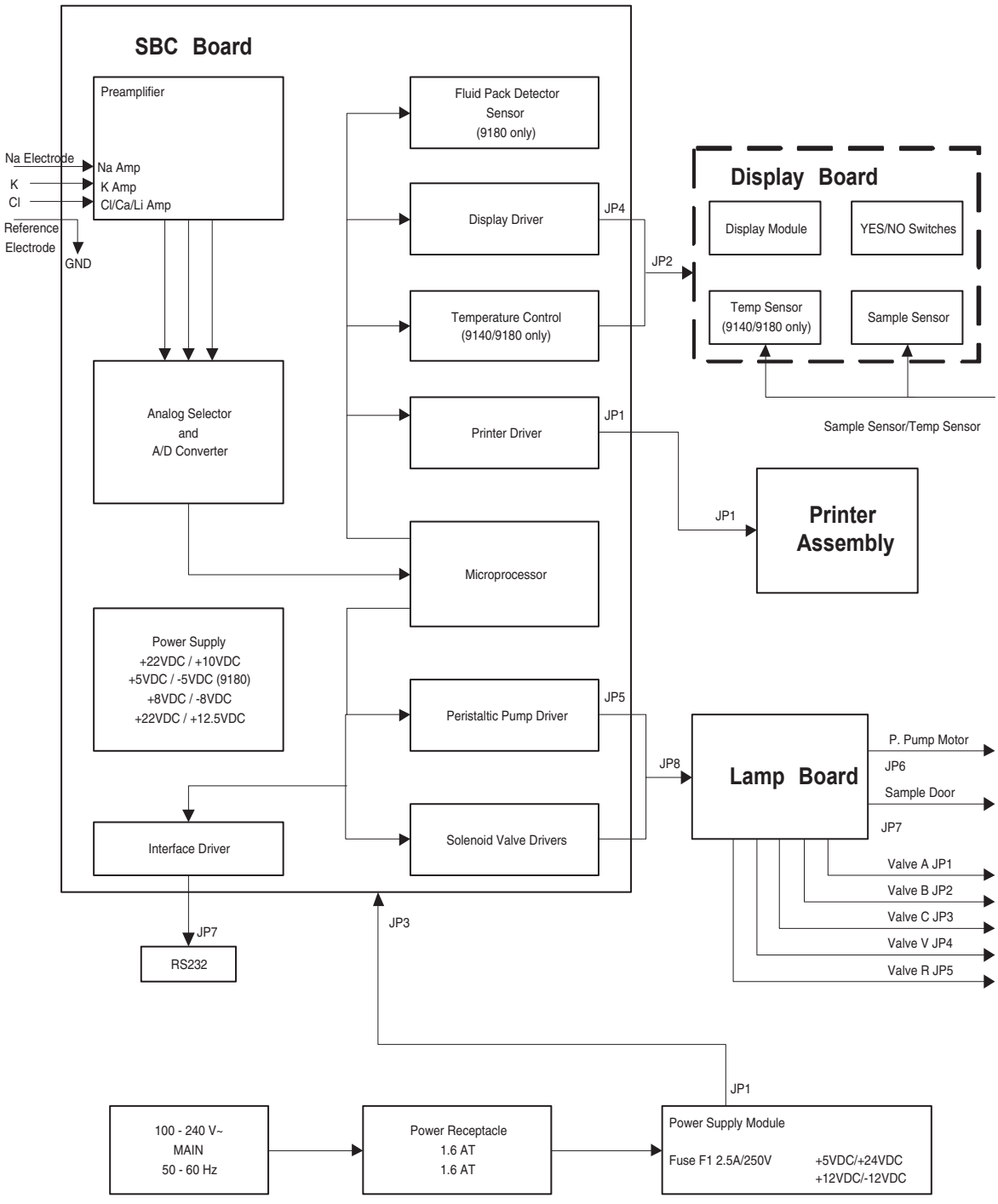


Figure A-5 9120, 9130, 9140, 9180 analyzer block diagram

9181 analyzer block diagram

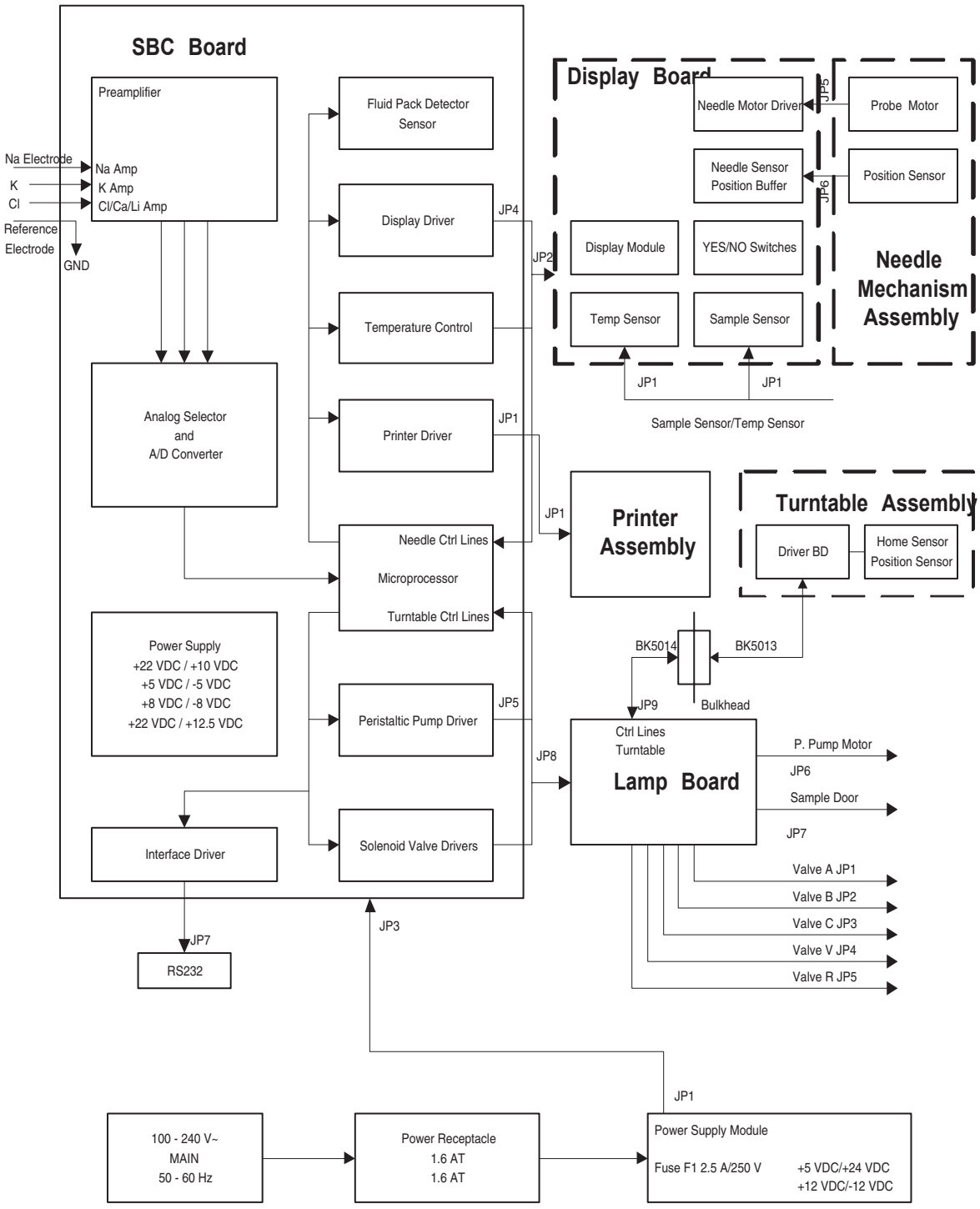


Figure A-6 9181 anayzer block diagram

System interconnect - 9110, 9120, 9130, 9140

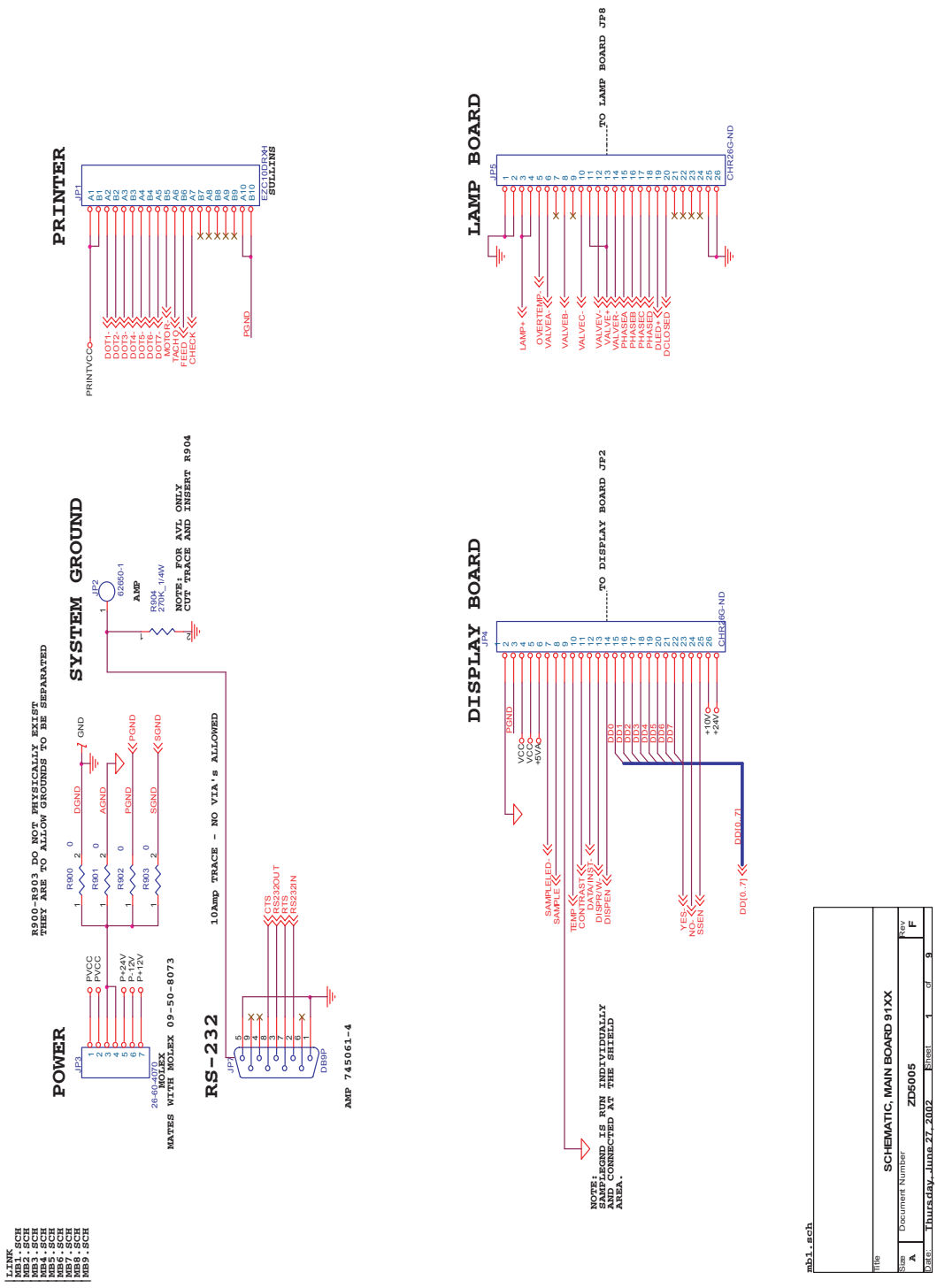


Figure A-7 System interconnect - 9110, 9120, 9130, 9140

SBC PCB – power supply – 9110, 9120, 9130, 9140

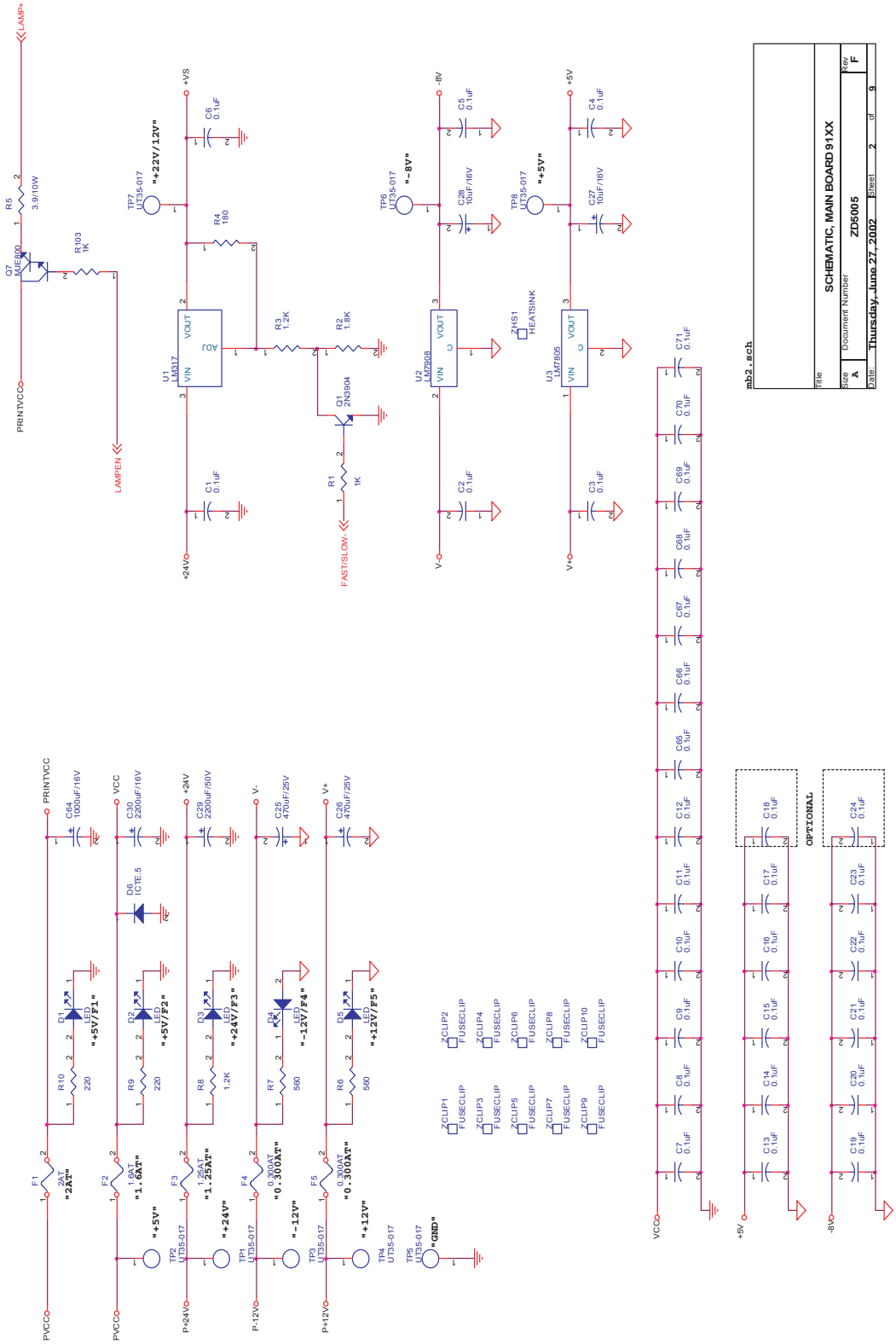


Figure A-8 SBC PCB – power supply – 9110, 9120, 9130, 9140

SBC PCB – valve drivers – 9110, 9120, 9130, 9140

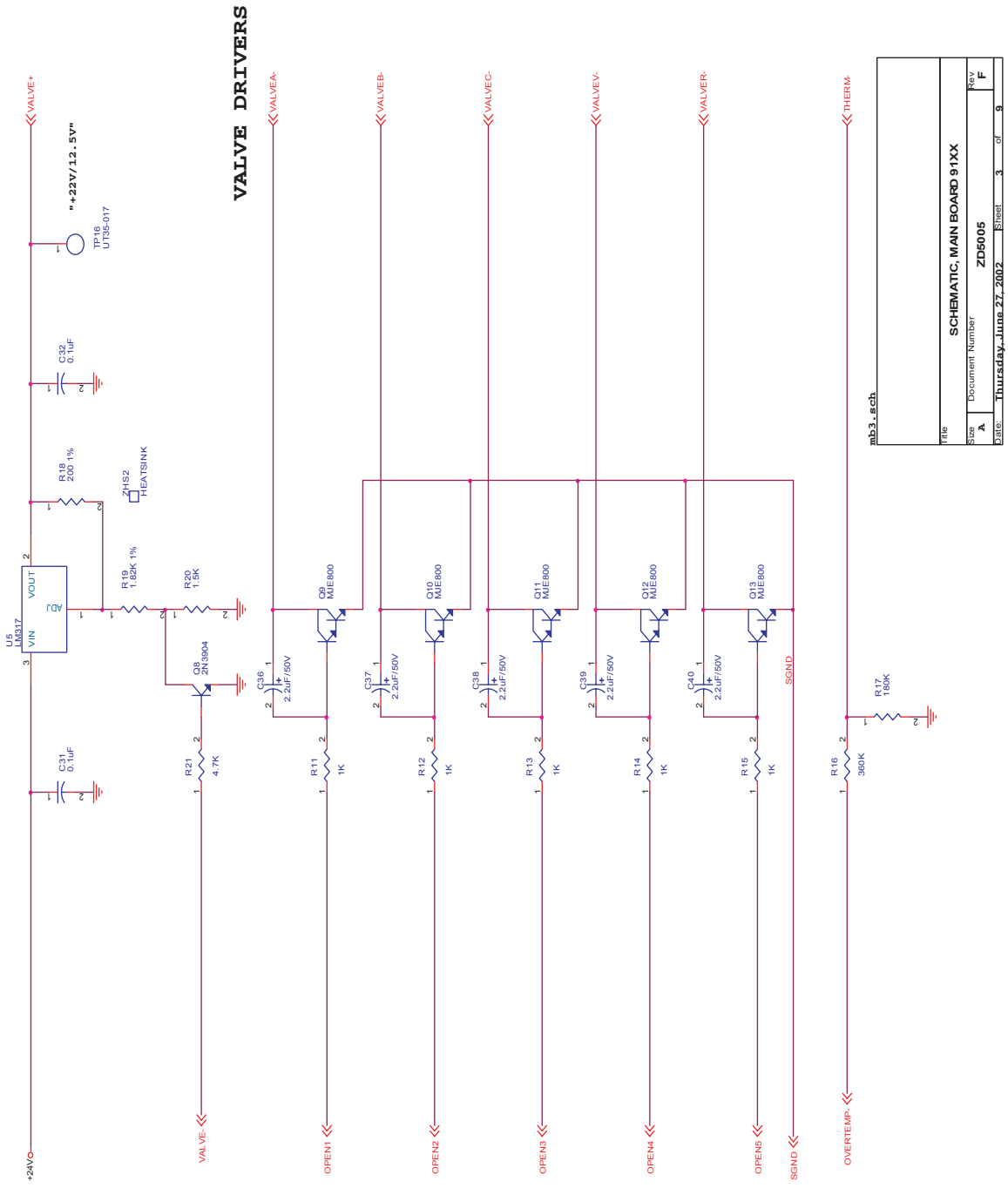


Figure A-9 SBC PCB – valve drivers – 9110, 9120, 9130, 9140

SBC PCB – pump motor driver / door detect – 9110, 9120, 9130, 9140

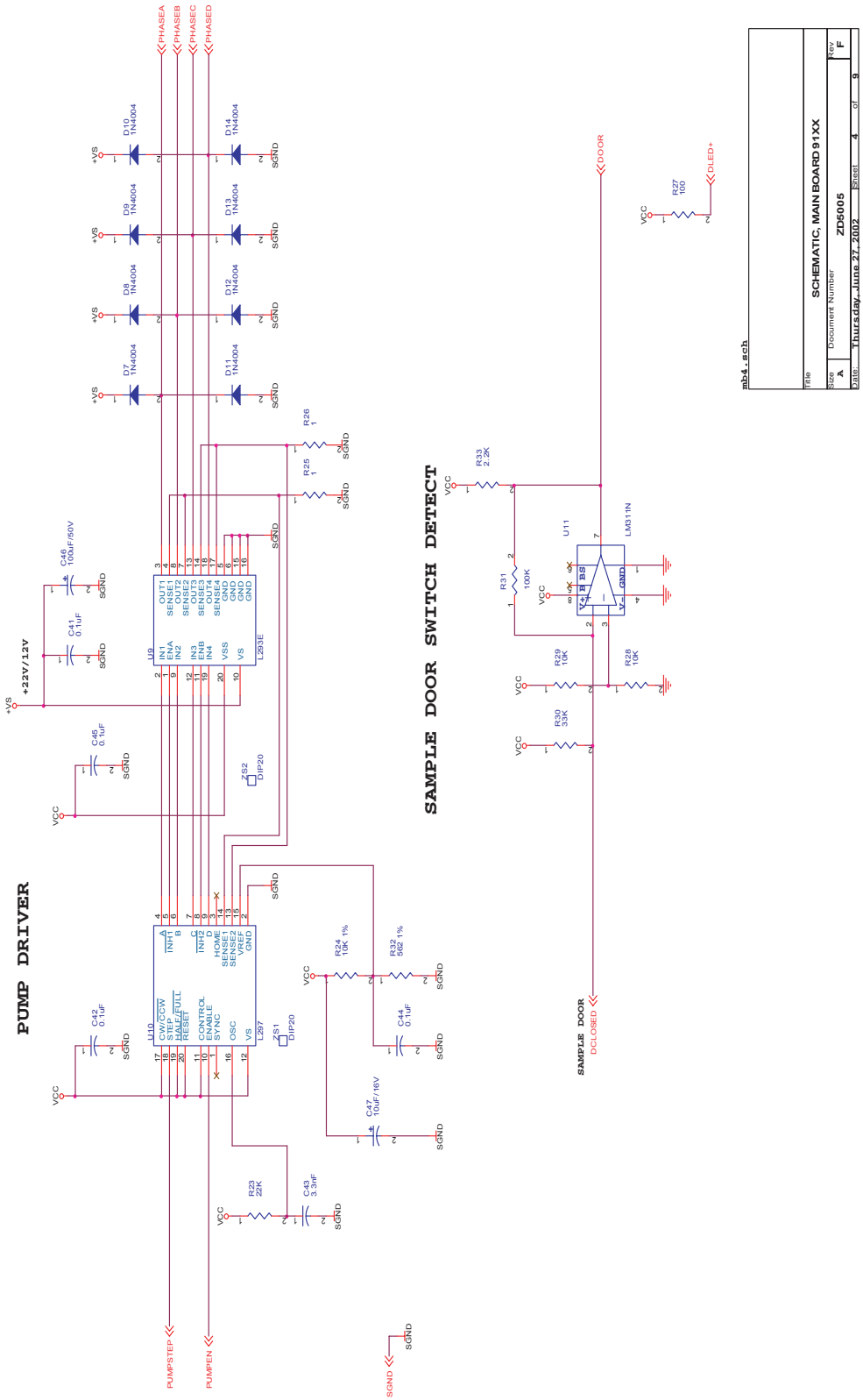


Figure A-10 SBC PCB - pump motor driver / door detect - 9110, 9120, 9130, 9140

SBC PCB – input amplifiers – 9110, 9120, 9130, 9140

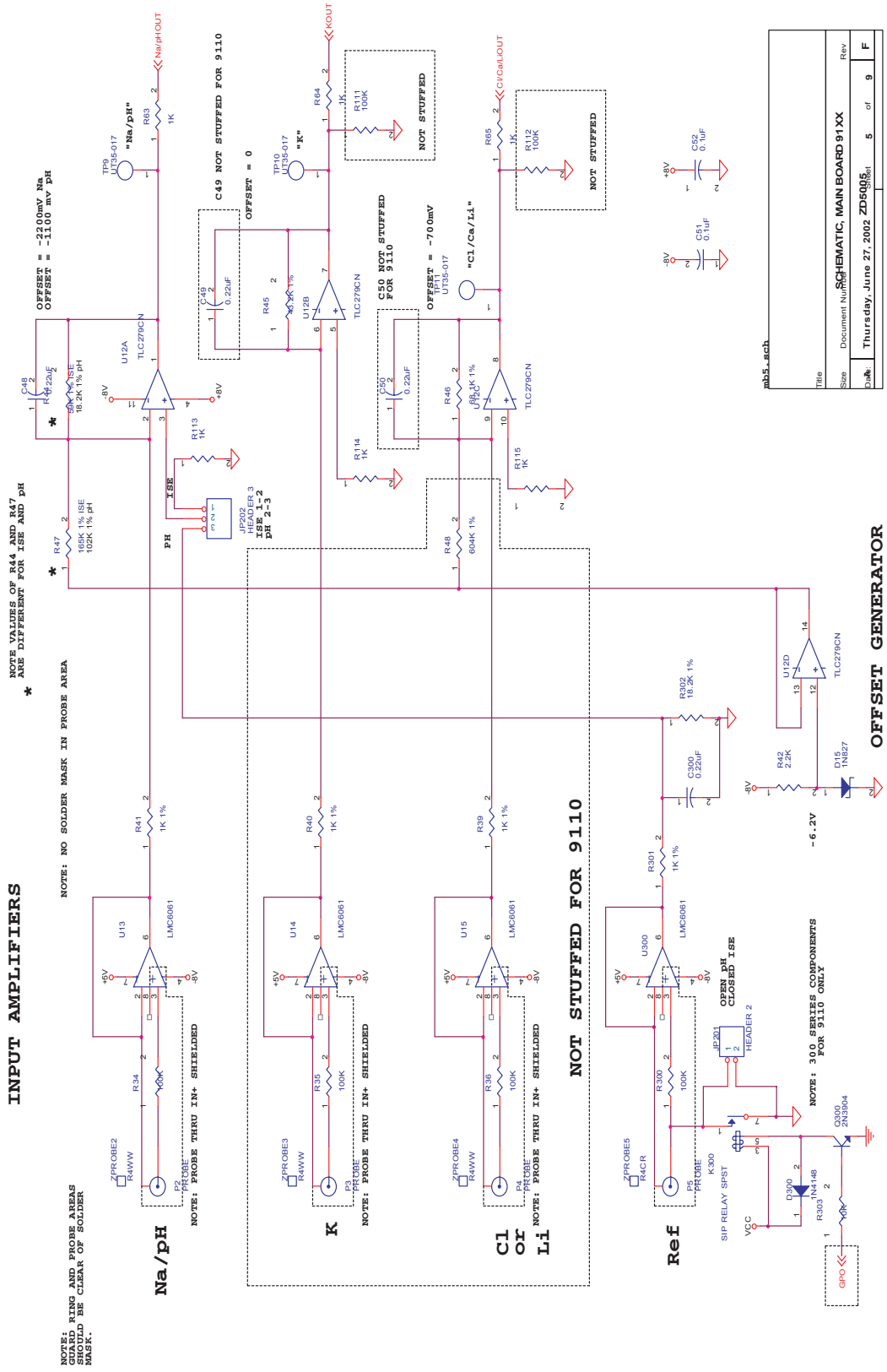


Figure A-11 SBC PCB - input amplifiers - 9110, 9120, 9130, 9140

SBC PCB – temperature circuit – 9110, 9120, 9130, 9140

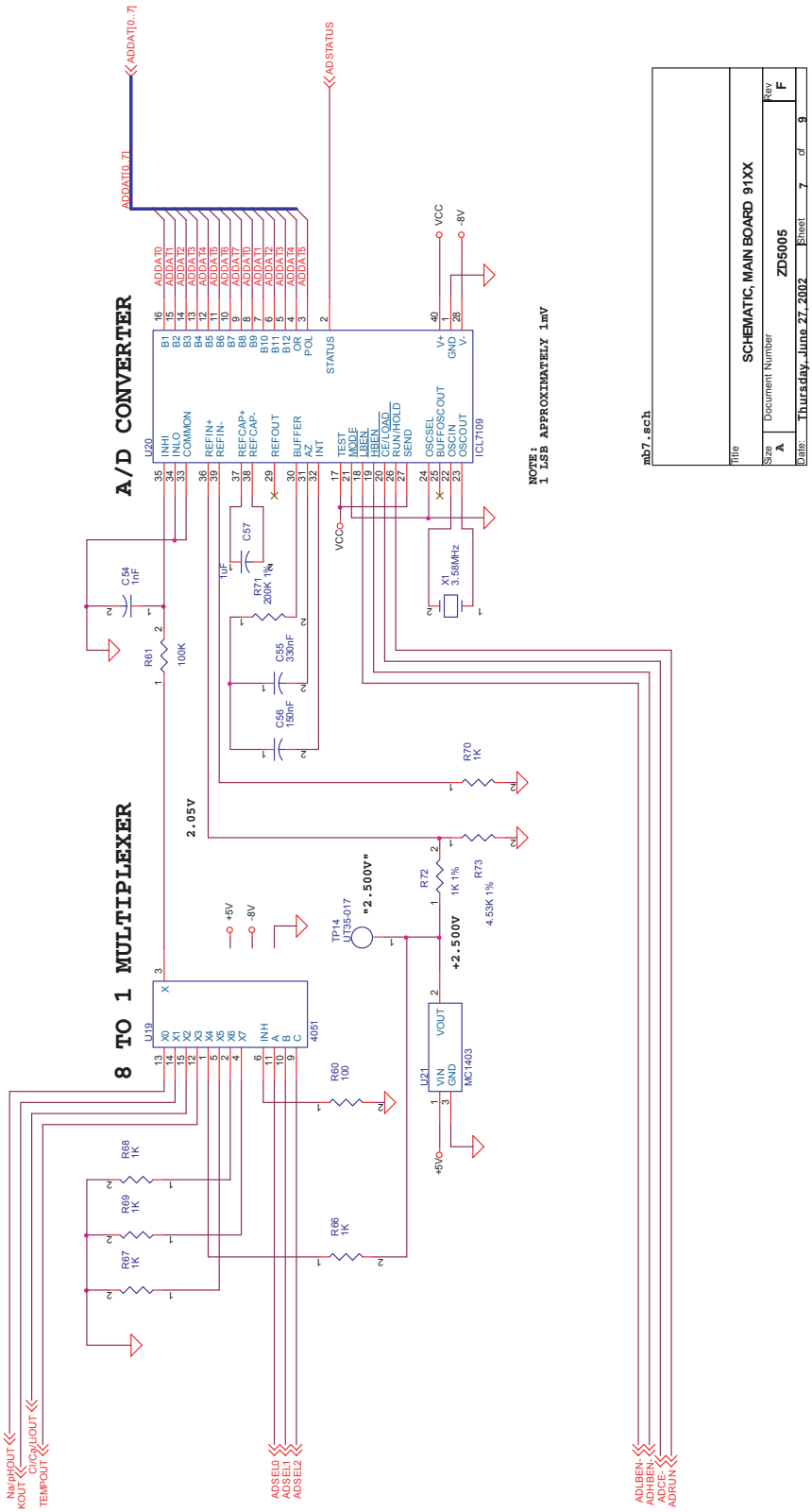


Figure A-12 SBC PCB - temperature circuit - 9110, 9120, 9130, 9140

SBC PCB – analog selector and A/D converter – 9110, 9120, 9130, 9140

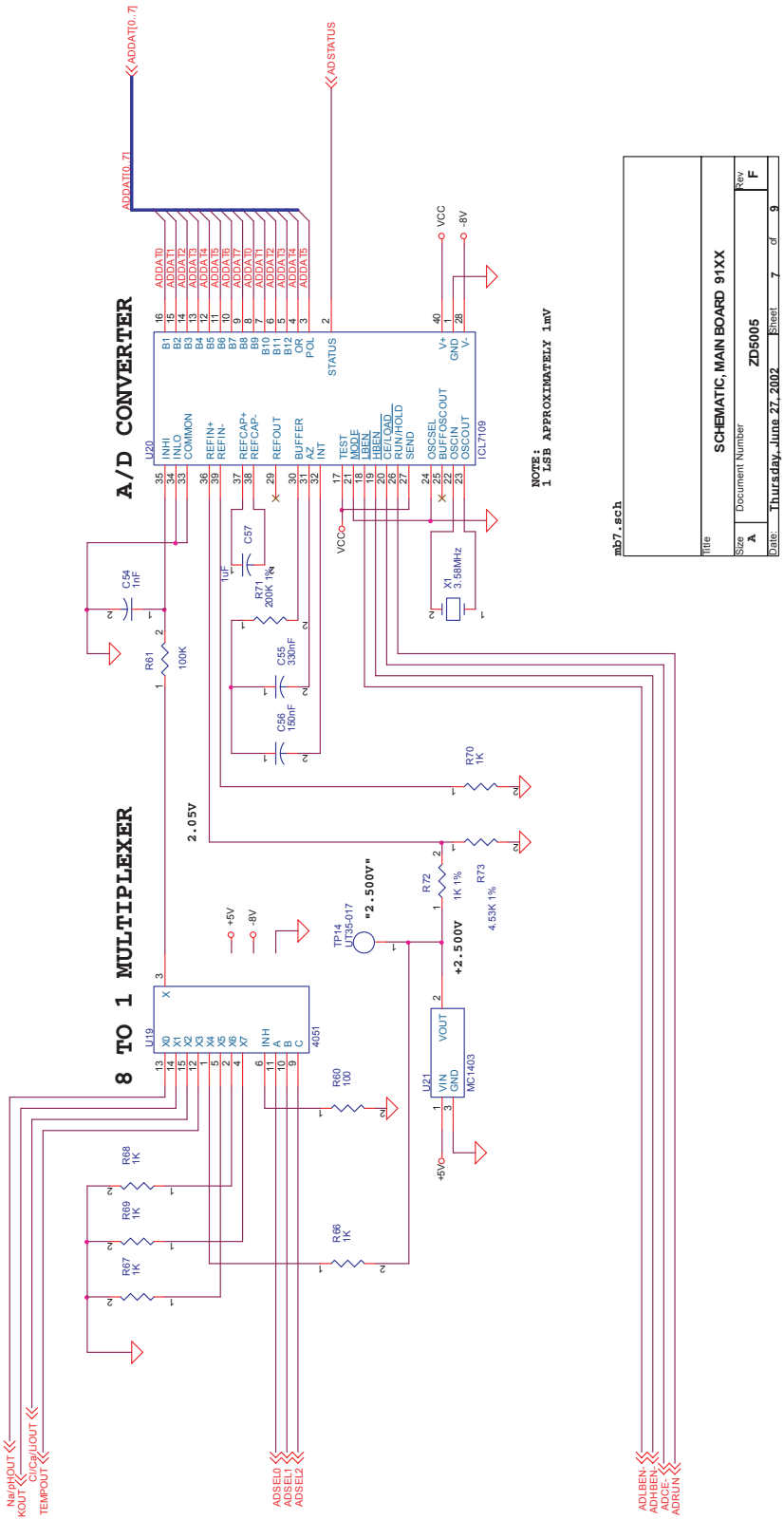


Figure A-13 SBC PCB - analog selector and A/D converter - 9110, 9120, 9130, 9140

SBC PCB – microprocessor – 9110, 9120, 9130, 9140

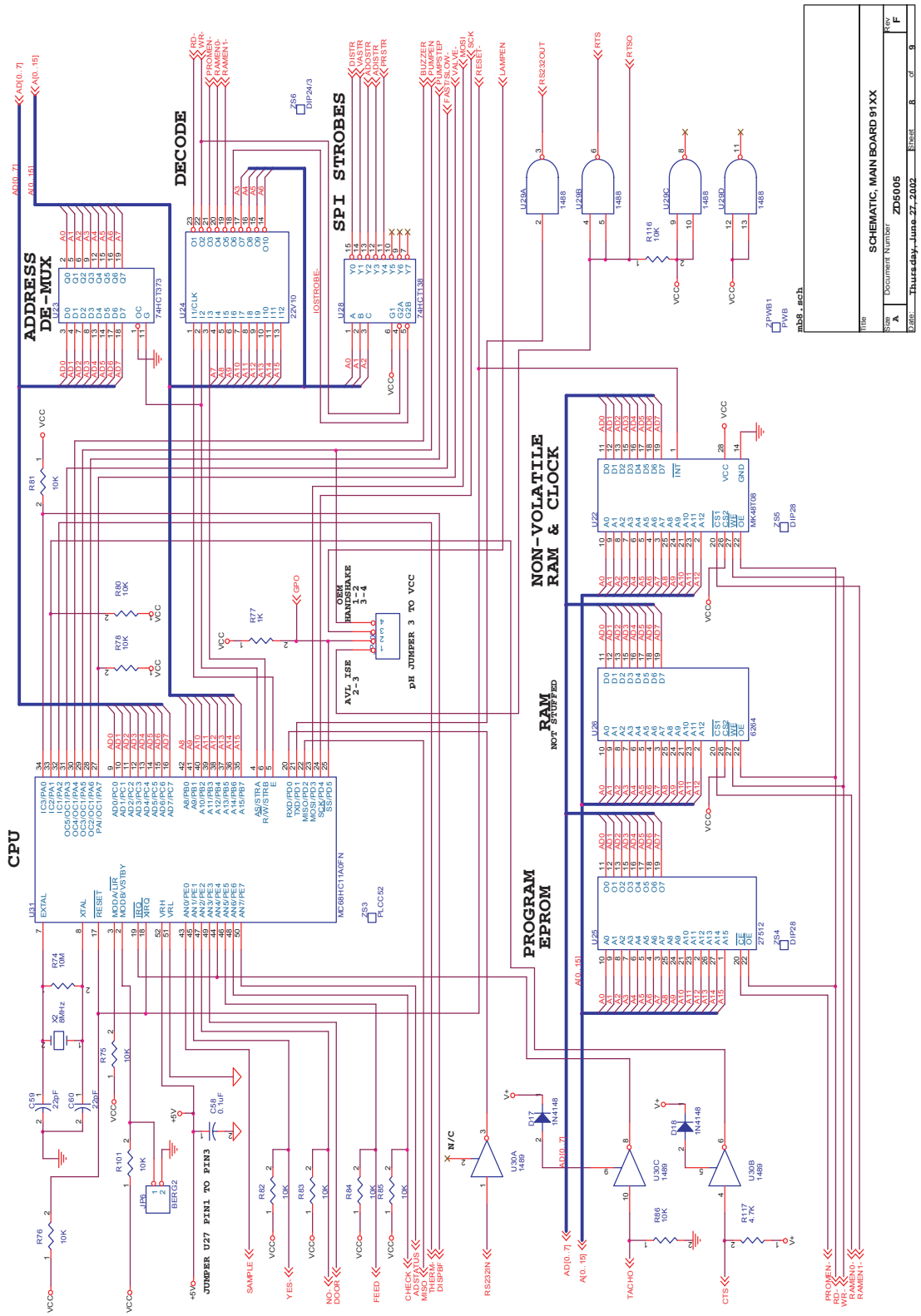


Figure A-14 SBC PCB - microprocessor - 9110, 9120, 9130, 9140

SBC PCB – printer display drivers – 9110, 9120, 9130, 9140

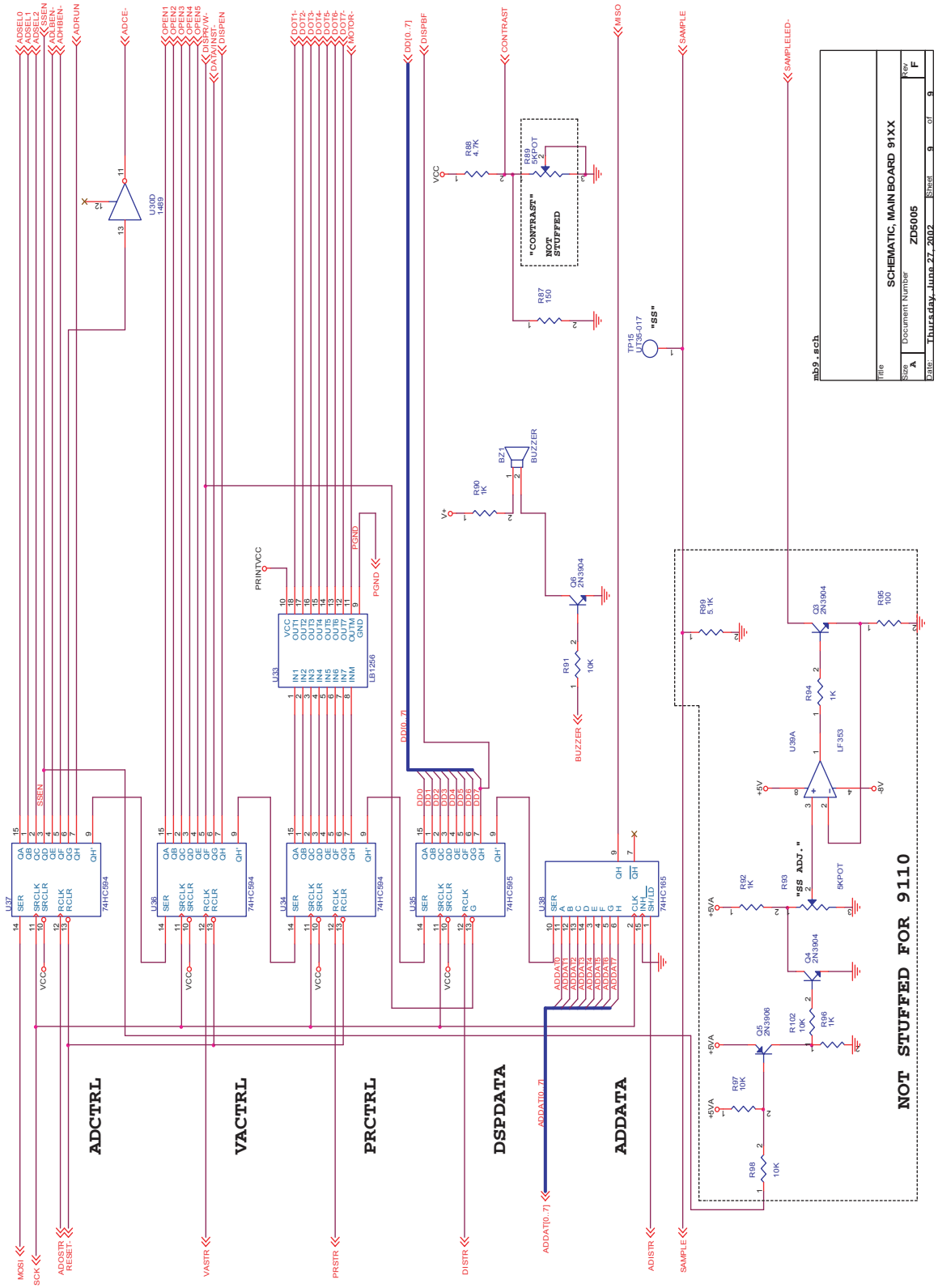


Figure A-15 SBC PCB - printer display drivers - 9110, 9120, 9130, 9140

Printer daughter PCB - 9110, 9120, 9130, 9140, 9180, 9181

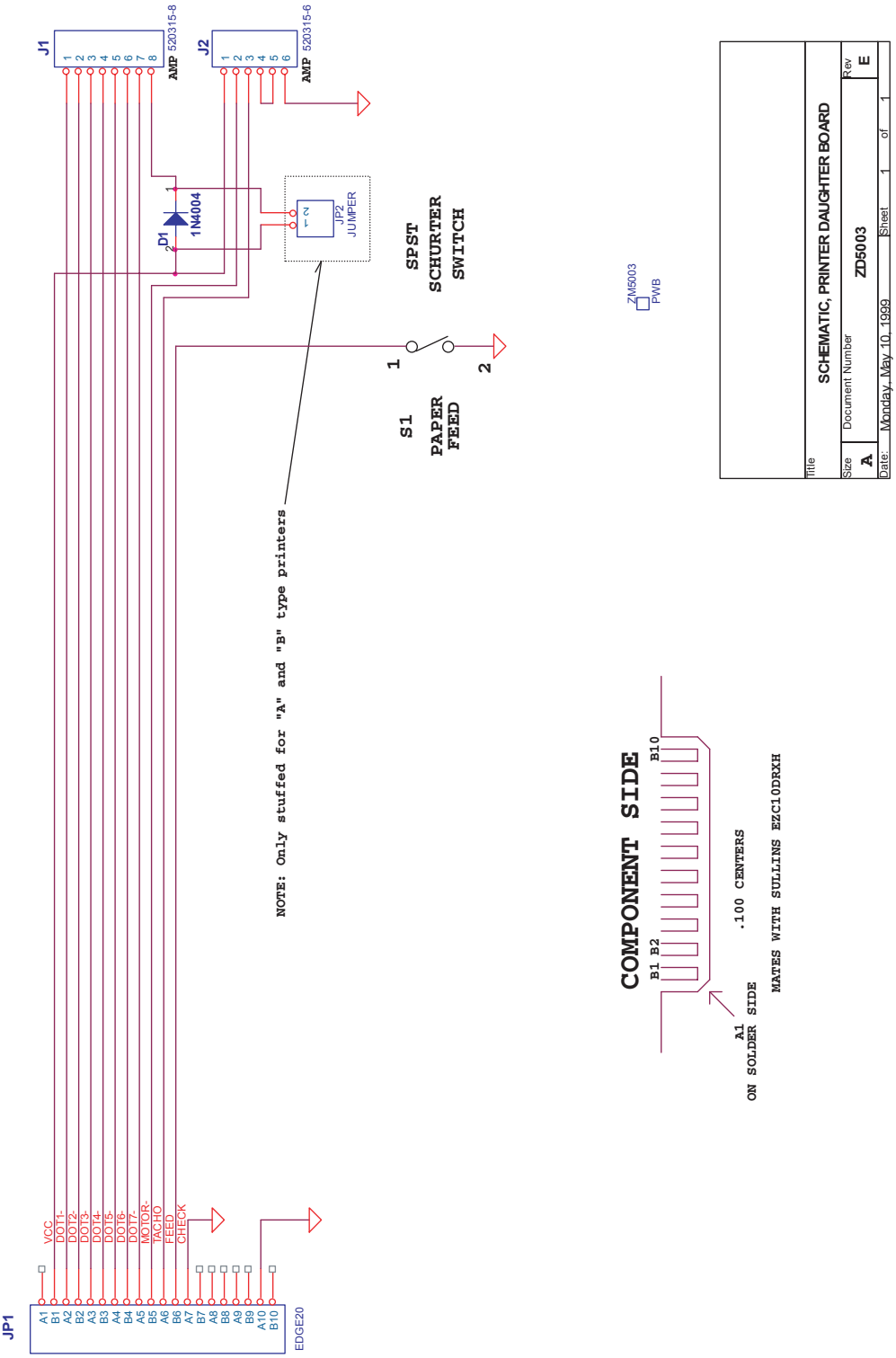


Figure A-16 Printer daughter PCB - 9110, 9120, 9130, 9140, 9180, 9181

Lamp PCB – 9110, 9120, 9130, 9140

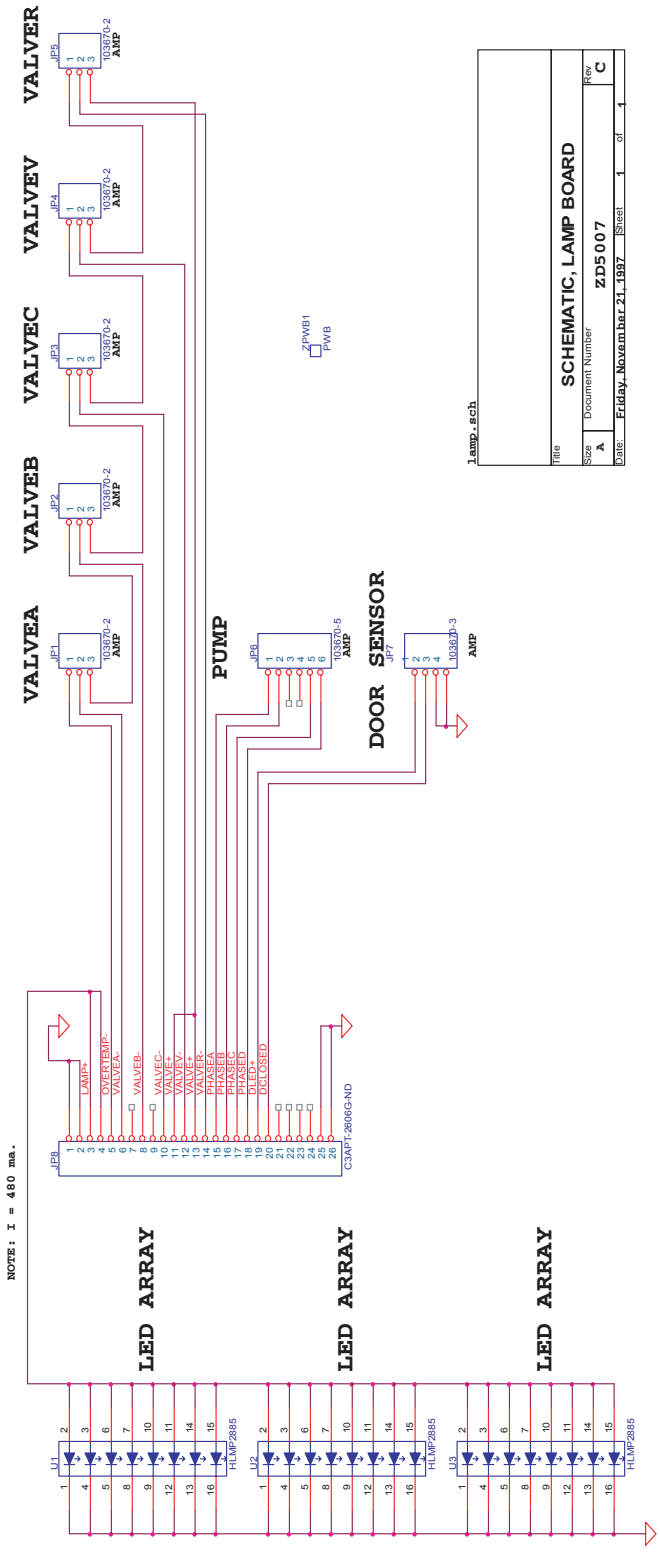


Figure A-17 Lamp PCB - 9110, 9120, 9130, 9140

Display daughter PCB - 9110

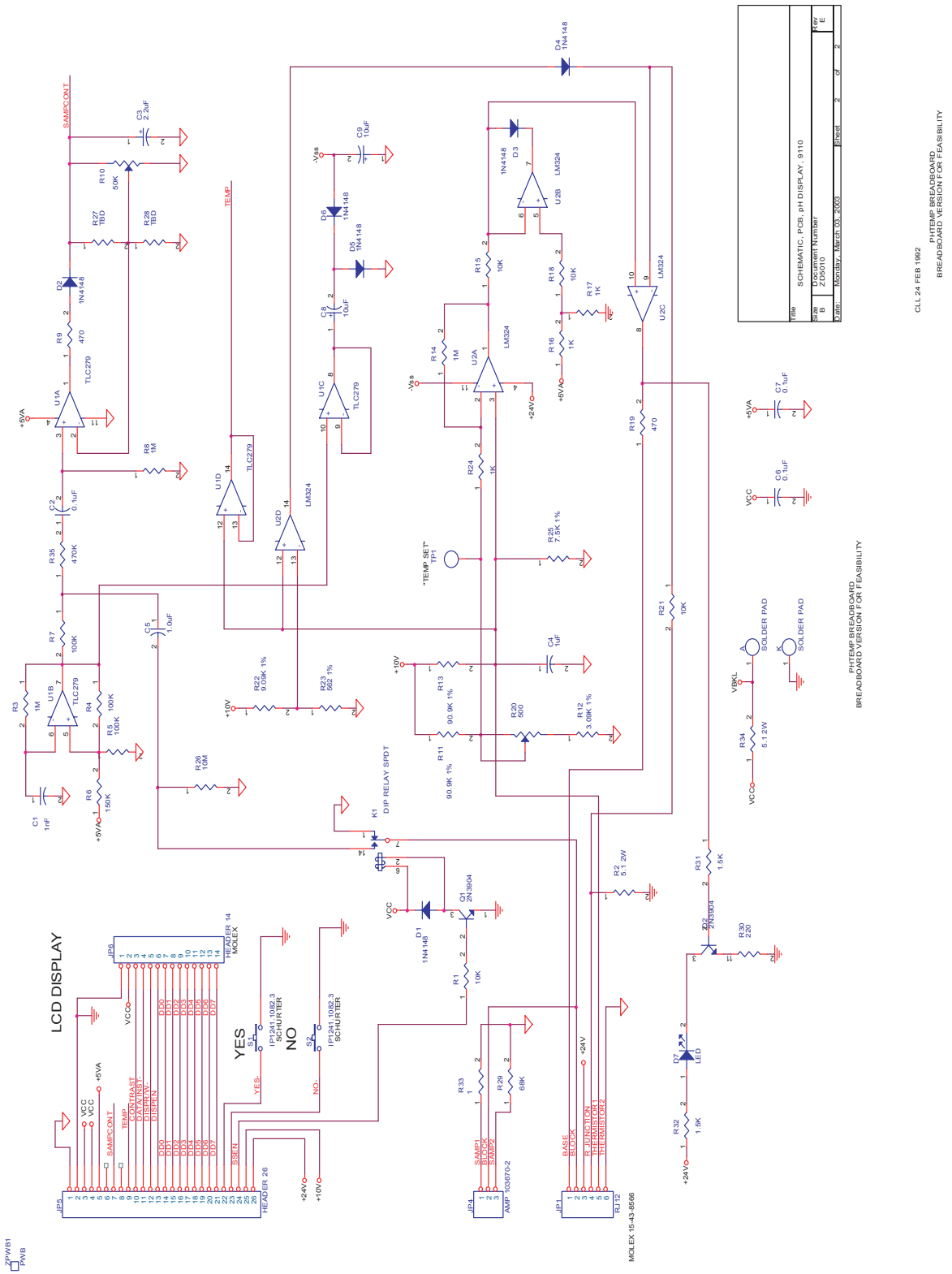


Figure A-18 Display daughter PCB - 9110

Preheater PCB - 9110

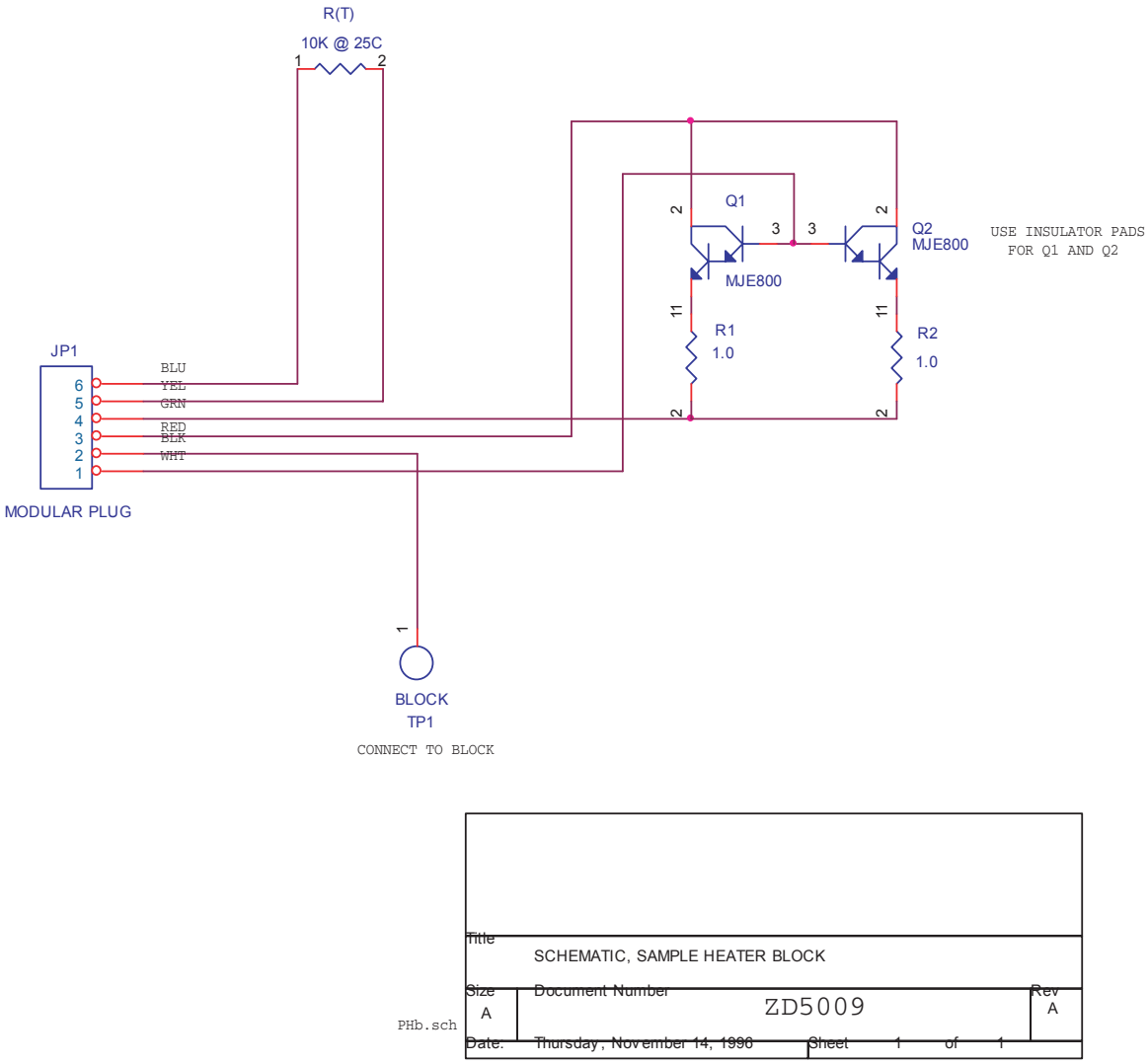


Figure A-19 Preheater PCB - 9110

Display daughter PCB - 9120, 9130, 9140

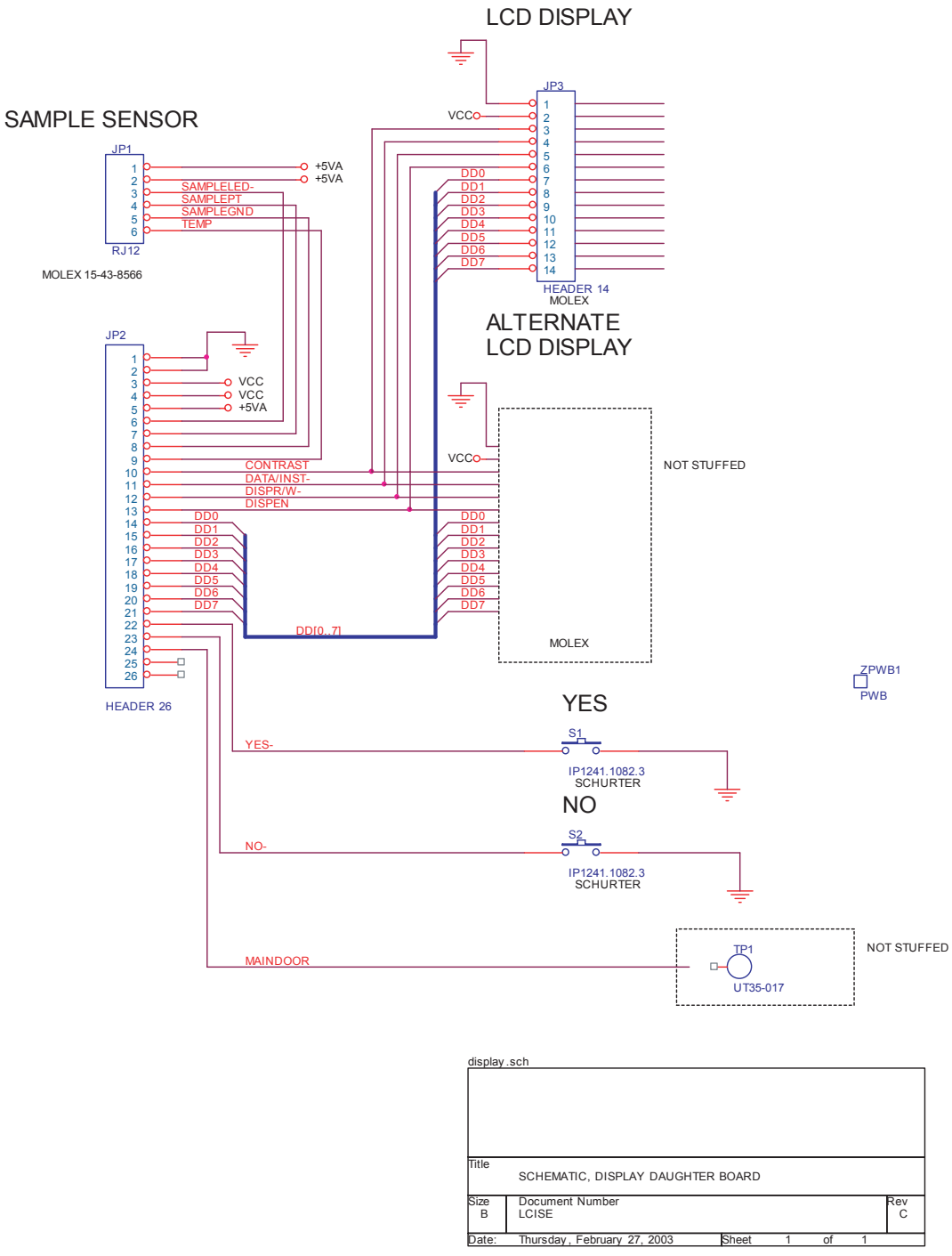


Figure A-20 Display daughter PCB - 9120, 9130, 9140

System interconnect - 9180, 9181

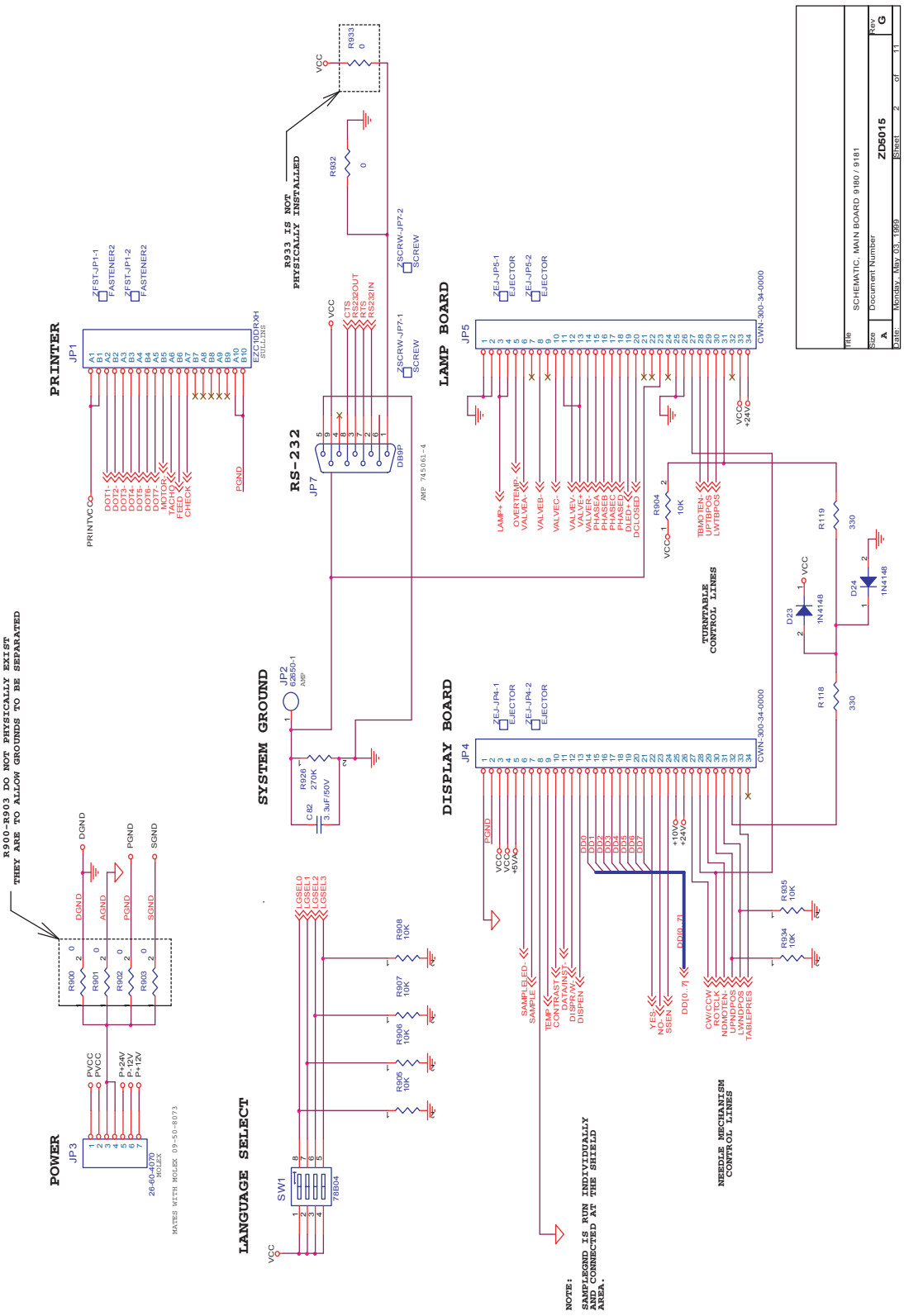


Figure A-21 System interconnect - 9180, 9181

SBC PCB – power supply – 9180, 9181

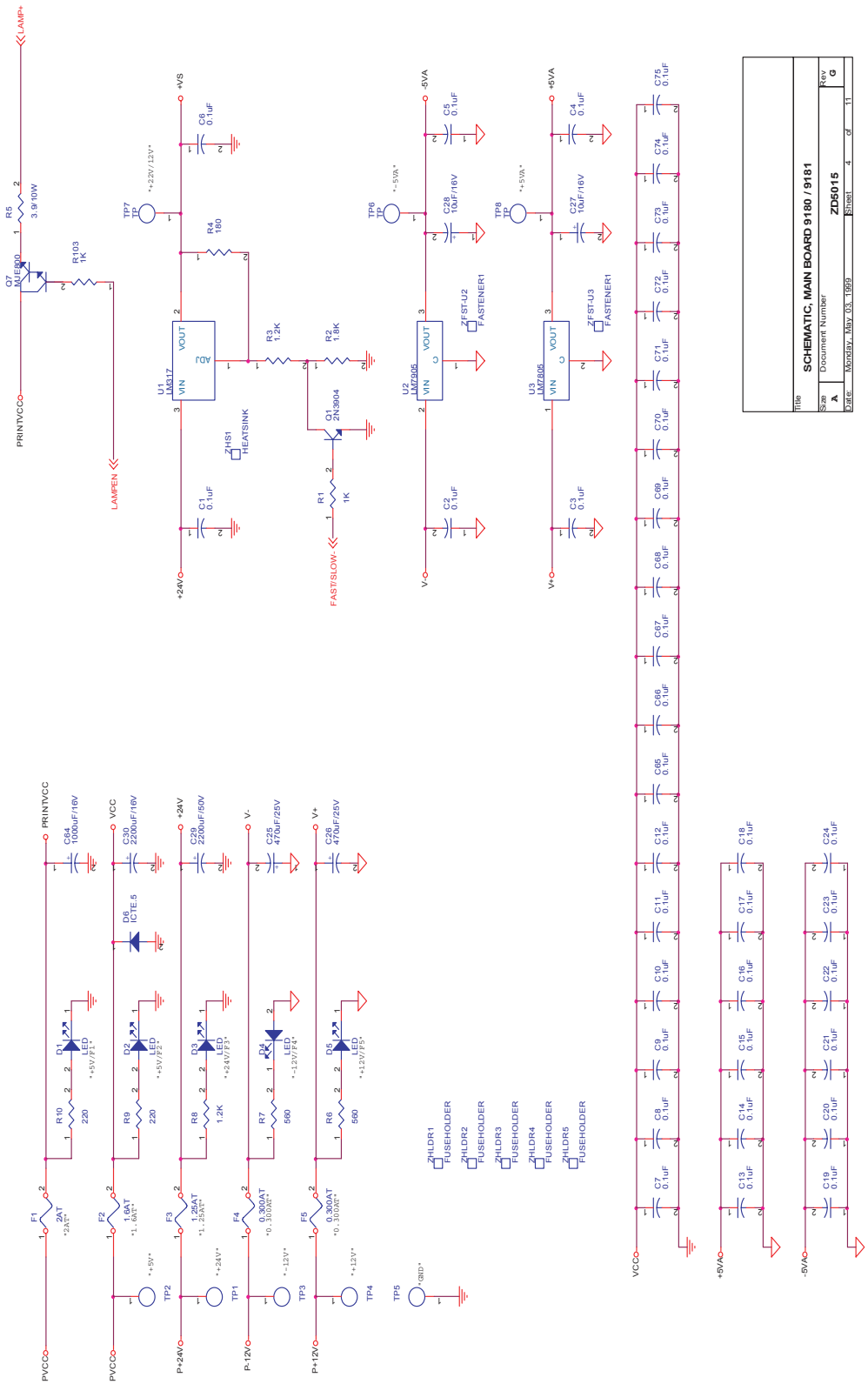


Figure A-22 SBC PCB - power supply - 9180, 9181

SBC PCB – valve drivers – 9180, 9181

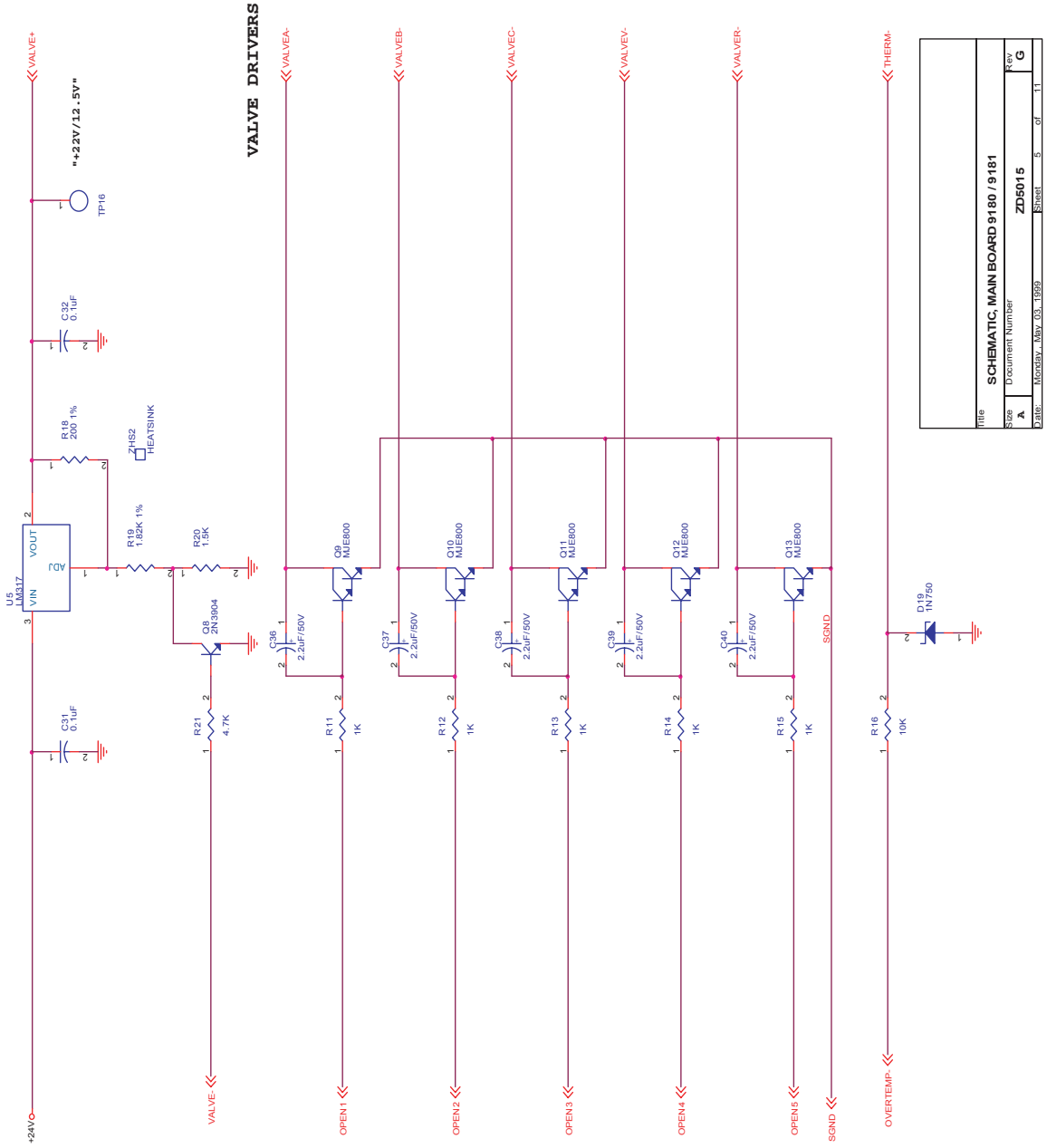


Figure A-23 SBC PCB - valve drivers - 9180, 9181

SBC PCB – pump motor driver/door detect – 9180, 9181

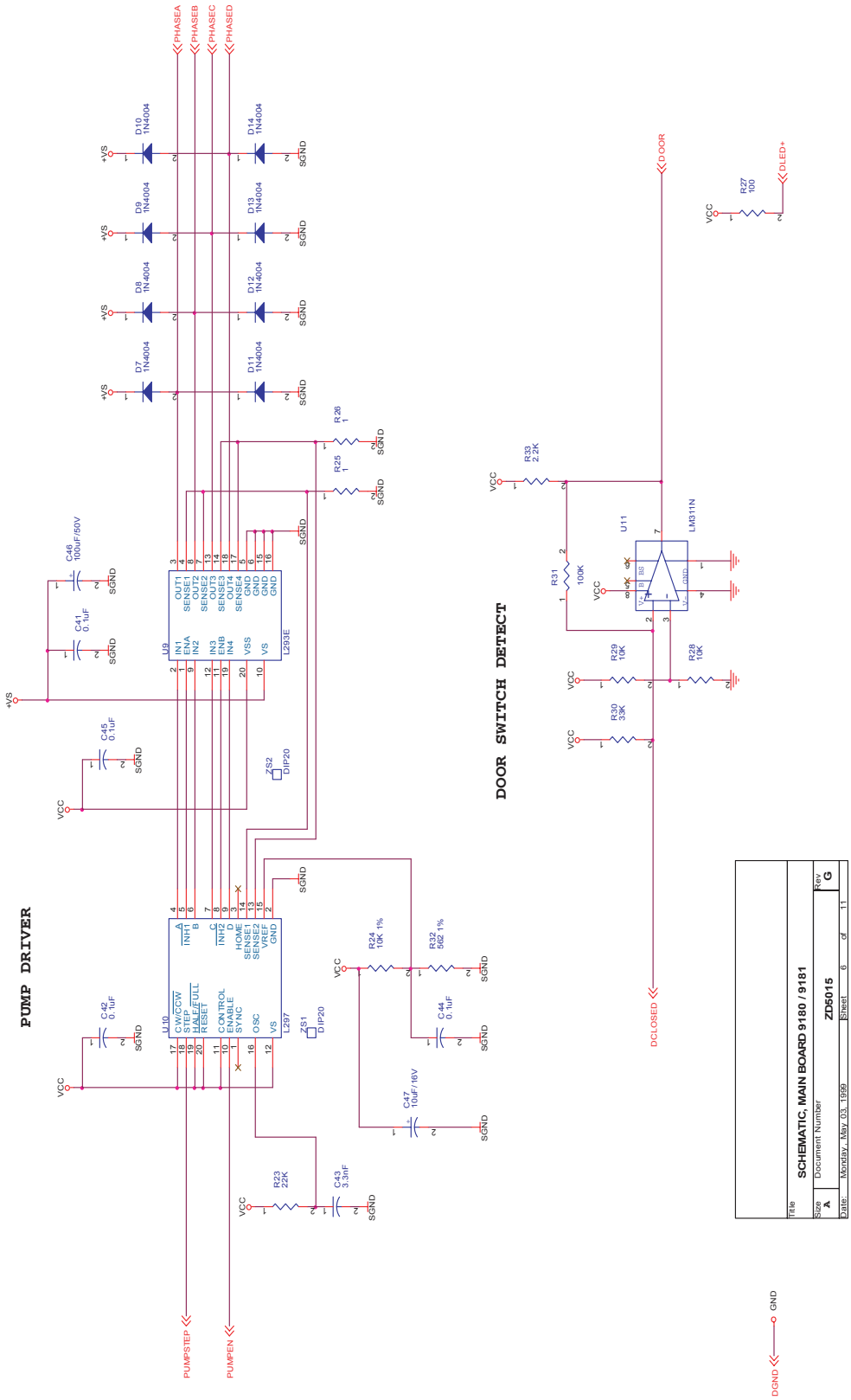


Figure A-24 SBC PCB - pump motor driver/door detect - 9180, 9181

SBC PCB – input amplifier – 9180, 9181

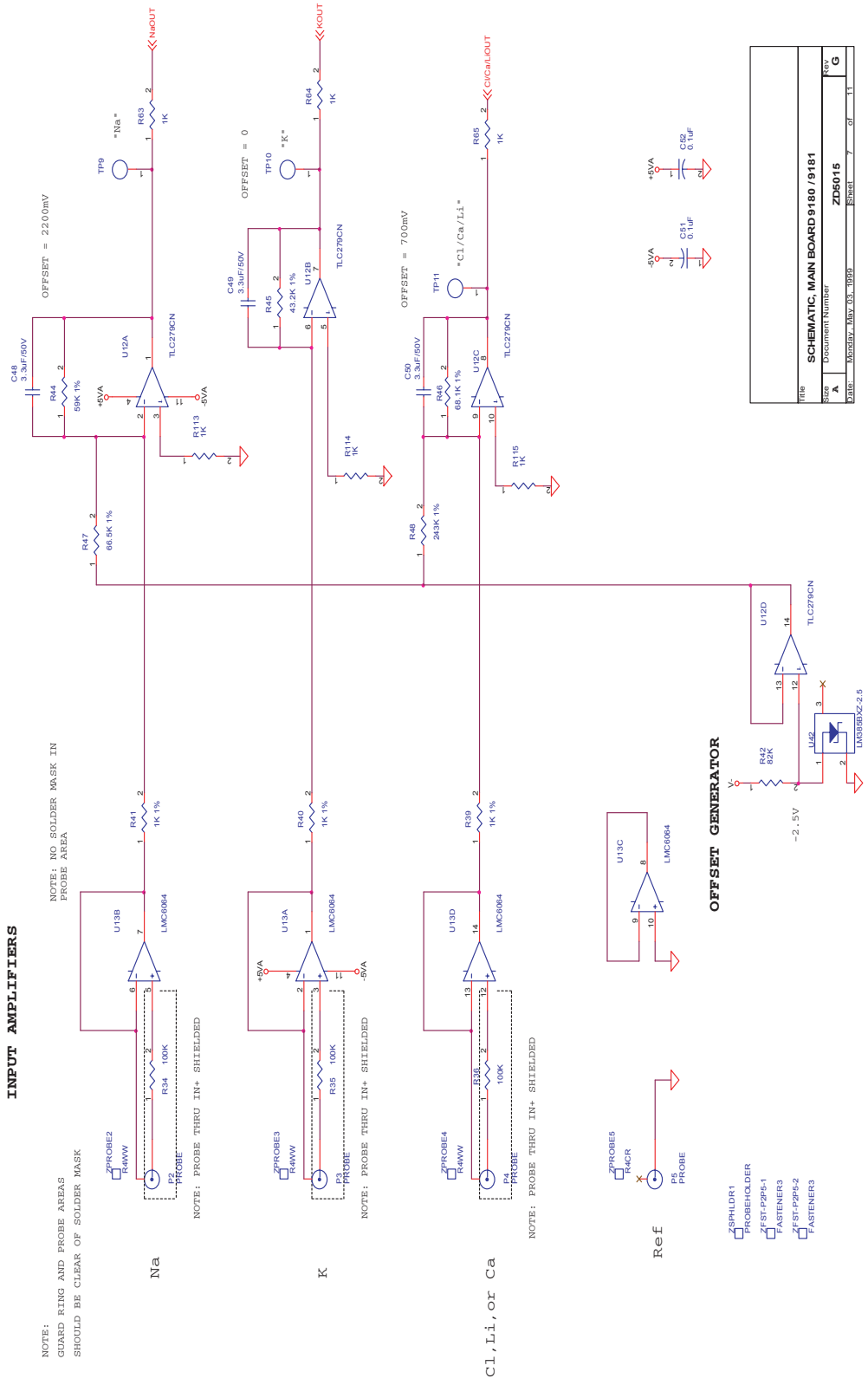


Figure A-25 SBC PCB - input amplifier - 9180, 9181

SBC PCB – temperature circuit – 9180, 9181

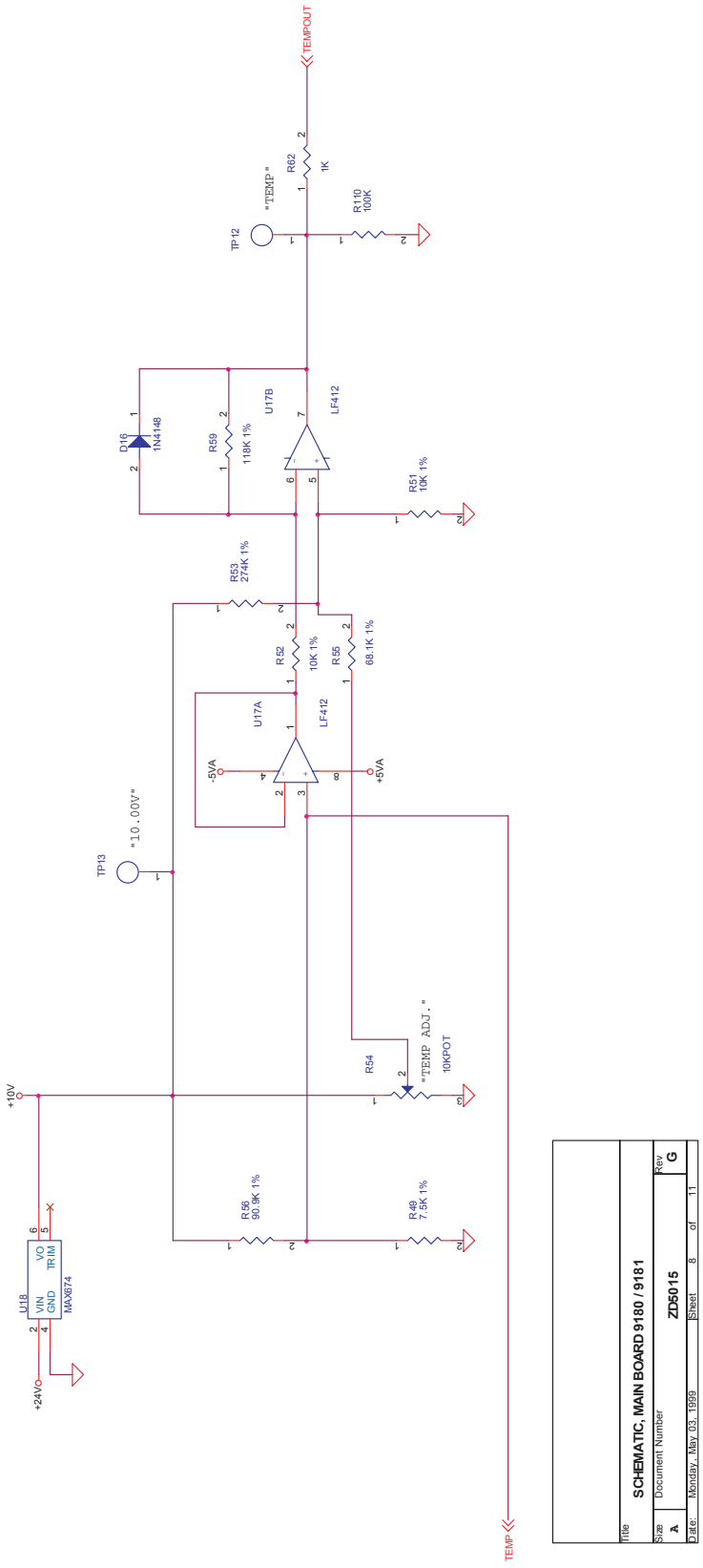


Figure A-26 SBC PCB - temperature circuit - 9180, 9181

SBC PCB - analog selector and A/D converter - 9180, 9181

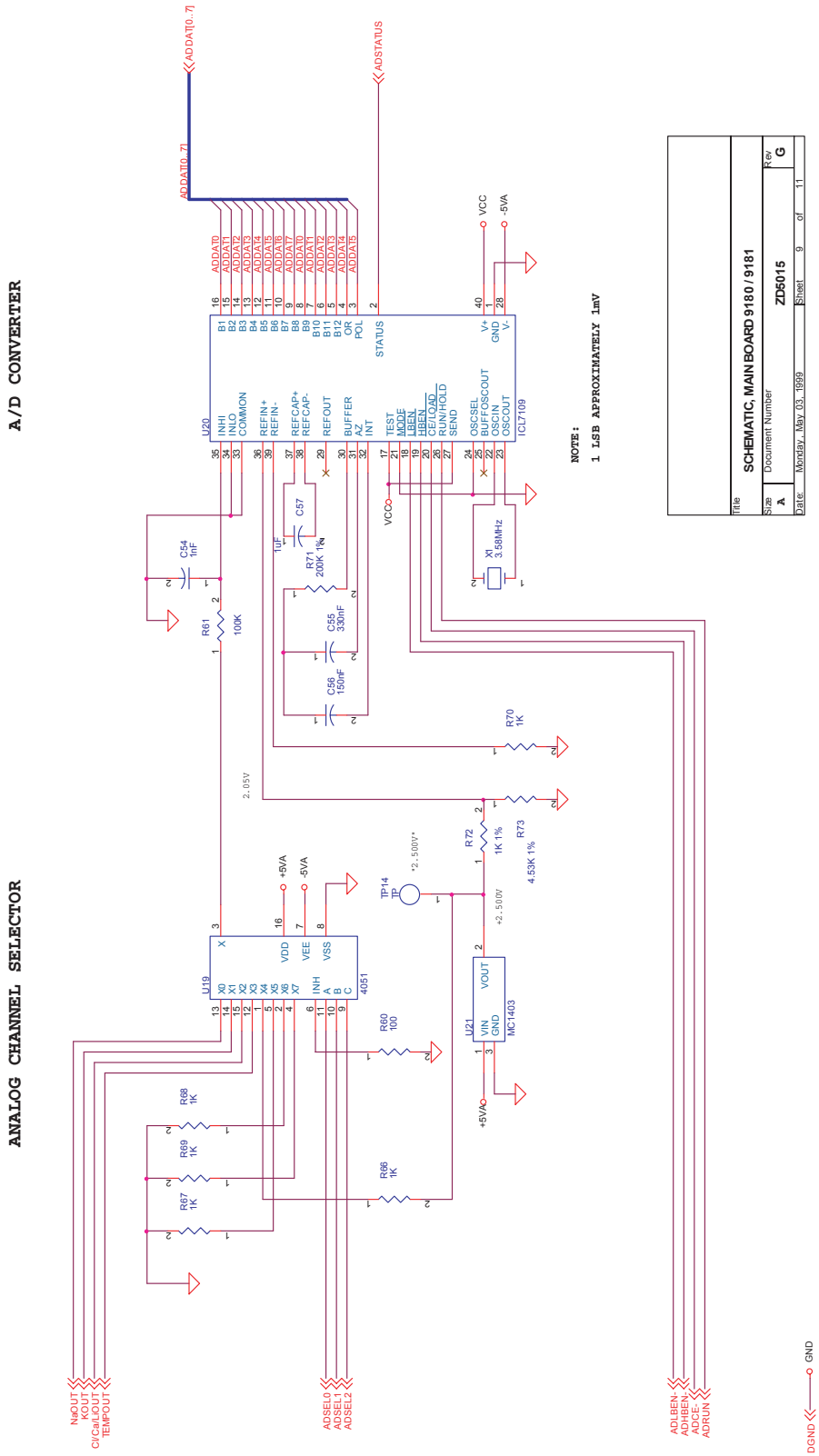


Figure A-27 SBC PCB - analog selector and A/D converter - 9180, 9181

SBC PCB – microprocessor – 9180, 9181

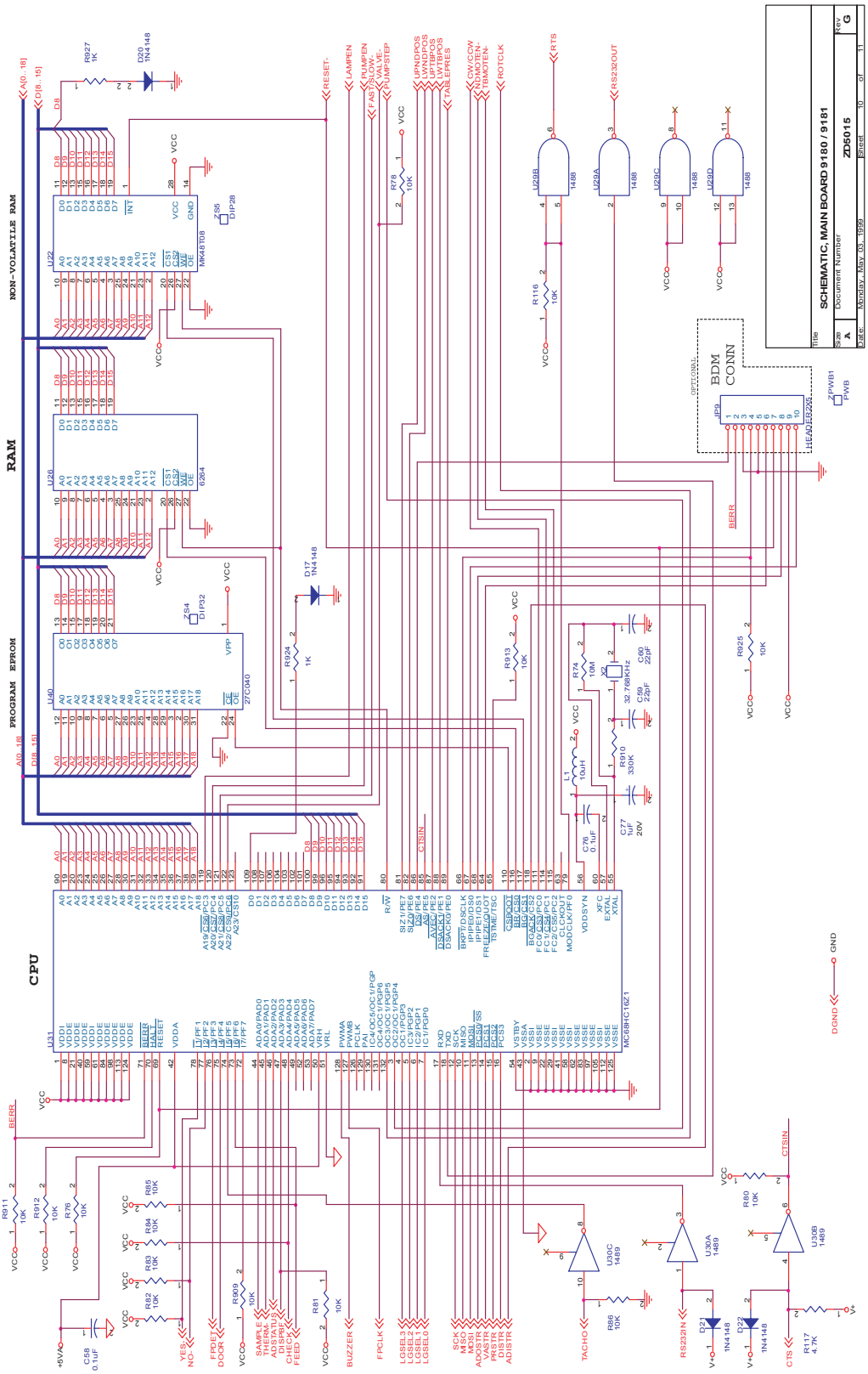


Figure A-28 SBC PCB - microprocessor - 9180, 9181

SBC PCB – microprocessor – 9180, 9181

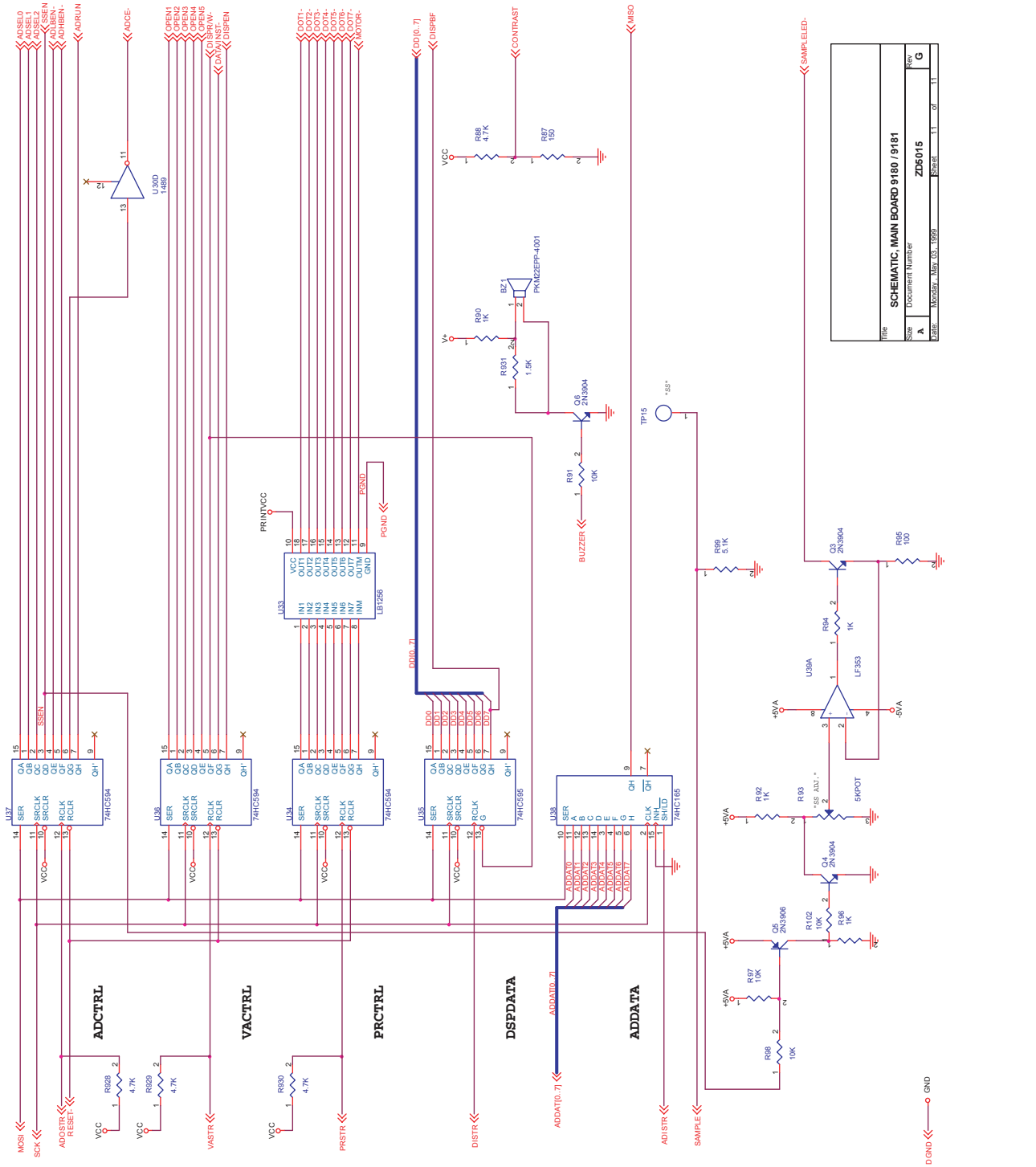


Figure A-29 SBC PCB – microprocessor – 9180, 9181

SBC PCB – Fluid pack detector – 9180, 9181

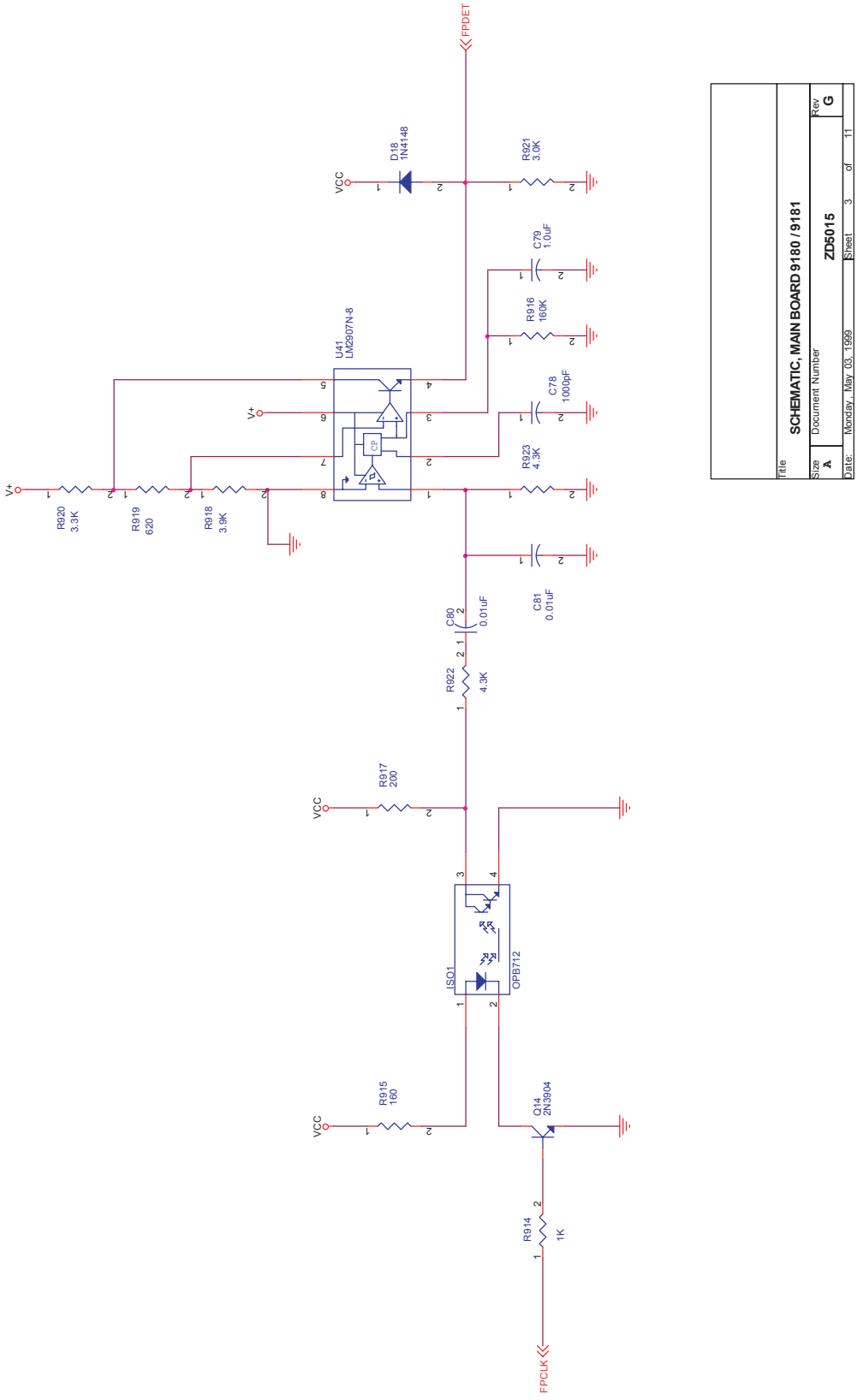


Figure A-30 SBC PCB - Fluid pack detector - 9180, 9181

Lamp PCB - 9180, 9181

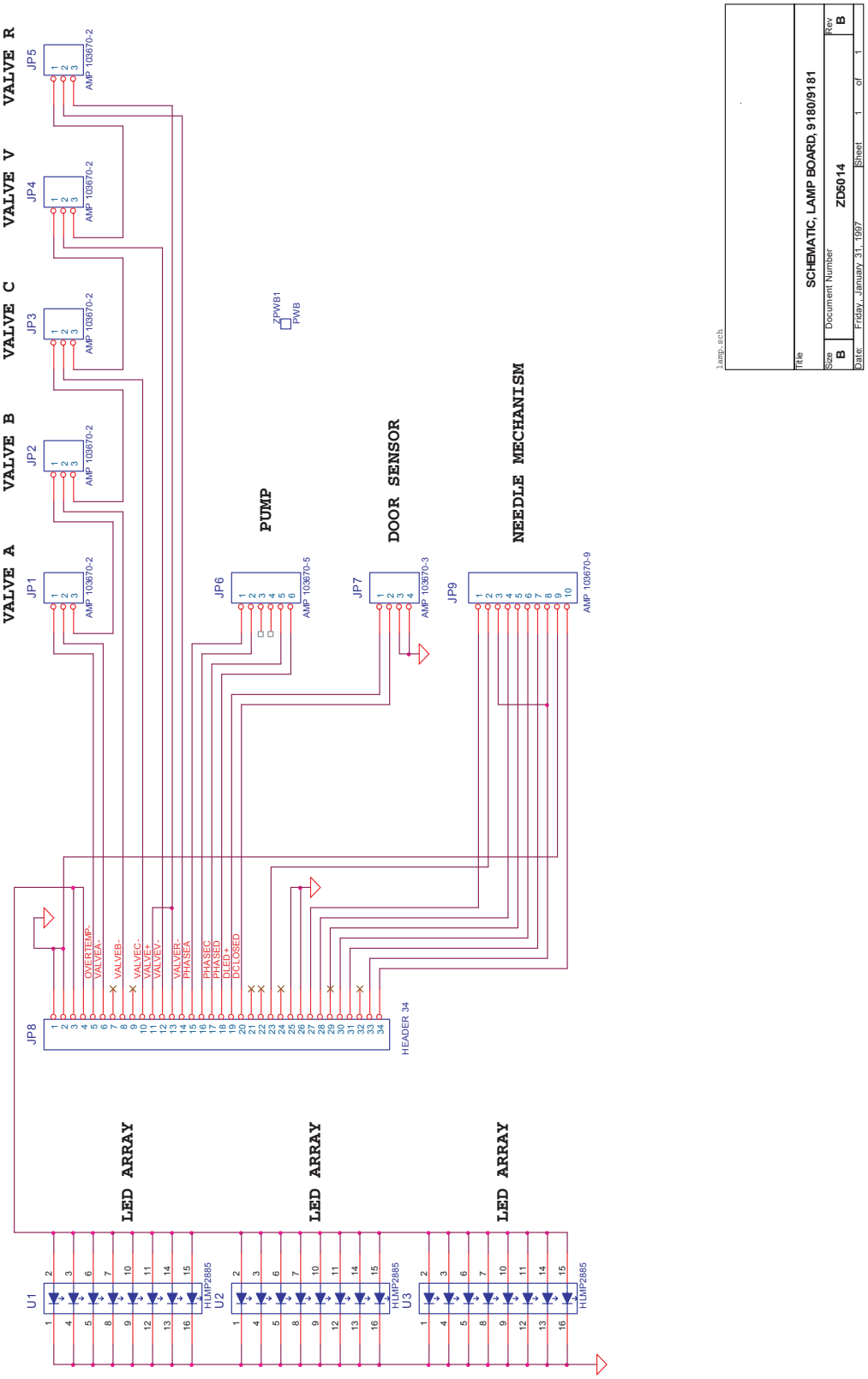


Figure A-31 Lamp PCB - 9180, 9181

Display daughter PCB - 9180

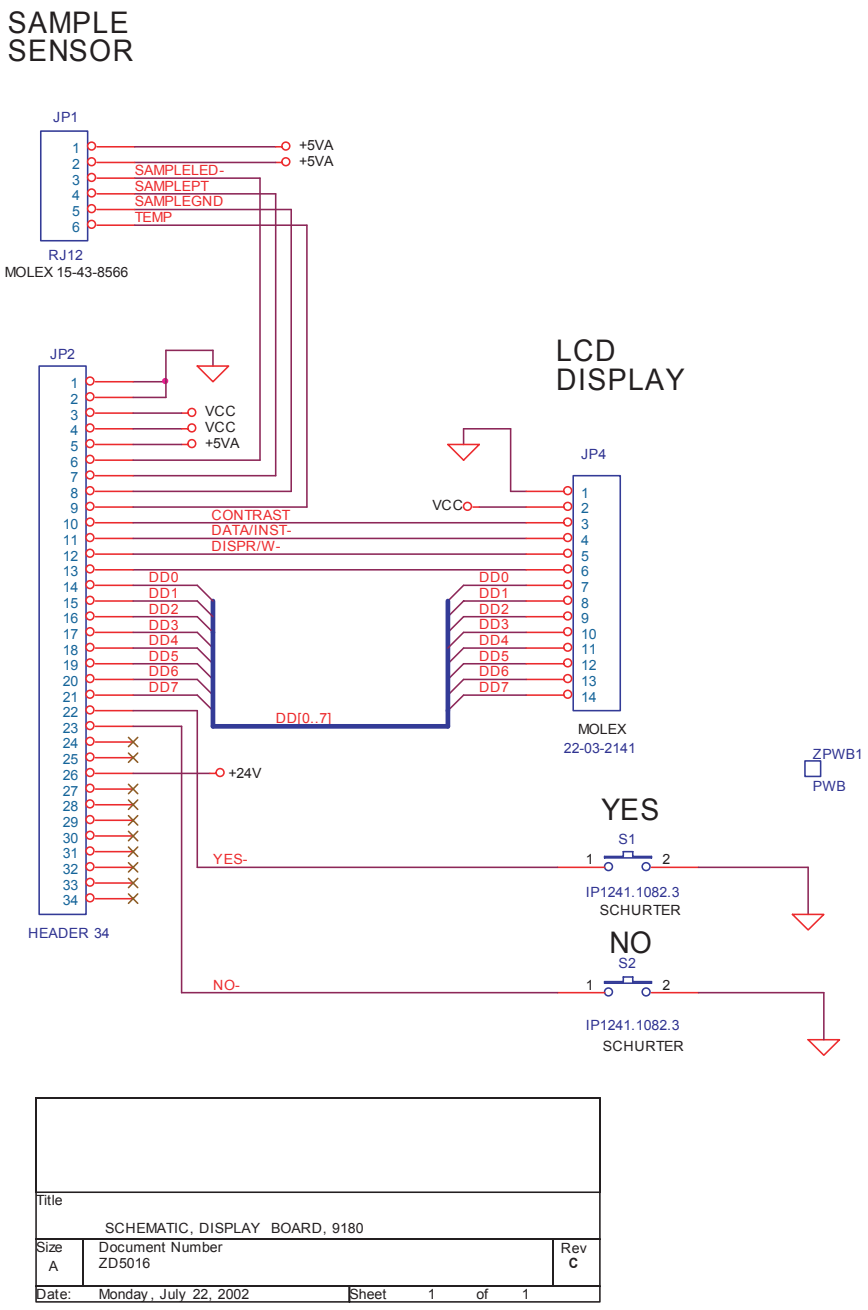


Figure A-32 Display daughter PCB - 9180

Software operation B

6 Software operation 9110 . . . . . B-3
7 Software operation 9120, 9130, 9140 . . . . . B-17
8 Software operation 9180 . . . . . B-31
9 Software operation 9181 . . . . . B-47
10 Service functions B-63

Software operation 9110

In this chapter

Chapter **6**

Software operation 9110 ..... B-5
Overview B-5
Overall program operation flow B-6
Main menu B-7
Measurement sequence B-8
Print functions menu B-9
QC sample menu B-10
Daily maintenance menu B-11
Operator functions menu B-12
Program instrument menu B-13
Service functions menu B-14
Calibration sequence B-15

Software operation 9110

Overview

Software operation of the 9110 pH Analyzers can be accessed by YES/NO selection on the analyzer front panel. The following flow chart diagrams are provided to identify operating sequences of the 9110 pH Analyzers:

1 Overall Program Operation Flow

2 Main Menu

3 Measurement Sequence

4 Print Functions Menu

5 QC/Standard/Urine Sample Menu

6 Electrode Cleaning Menu

7 Operator Functions Menu

8 Program Instrument Menu

9 Service Functions Menu

10 Calibration Sequence

Overall program operation flow

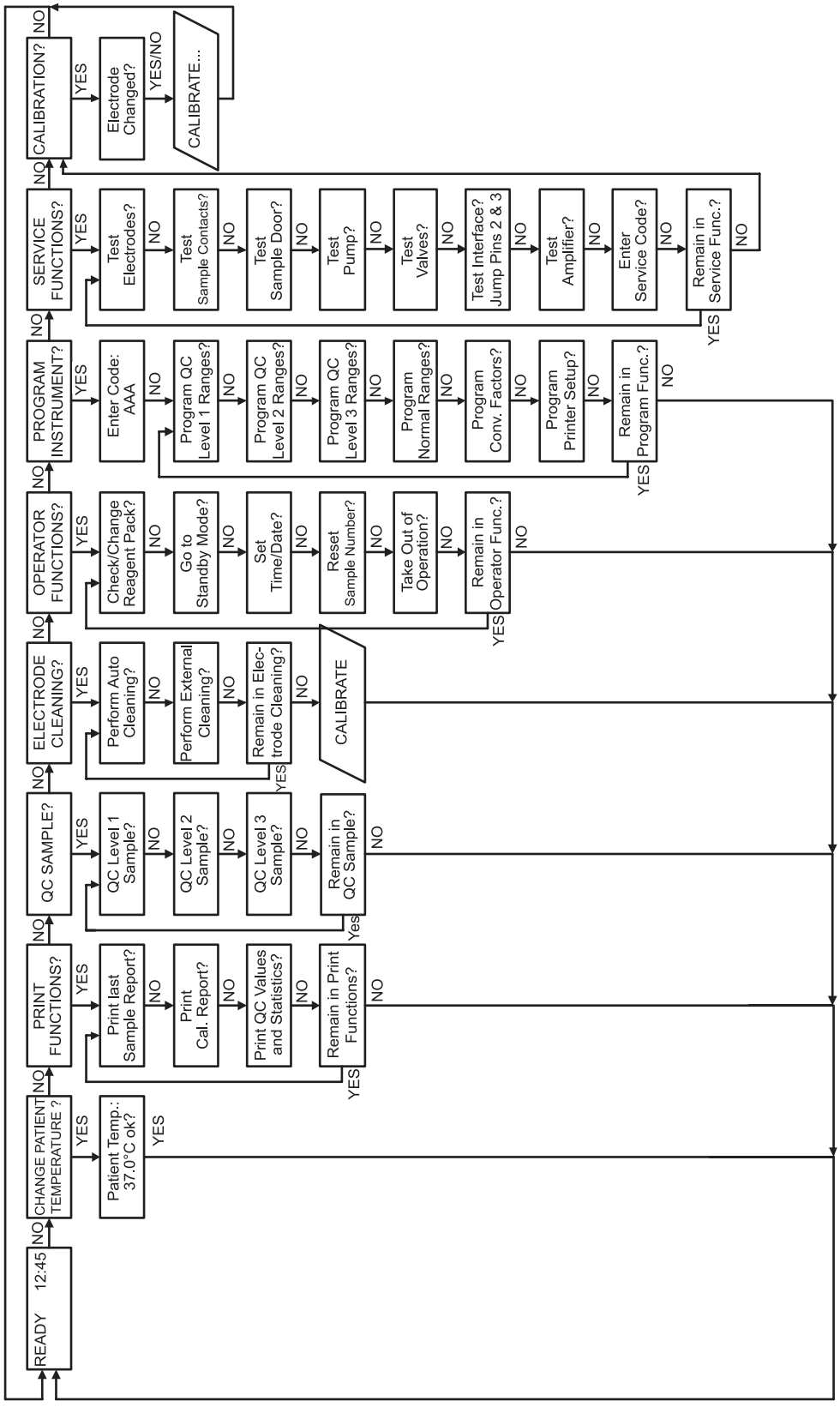


Figure B-1 9110 program flow

Main menu

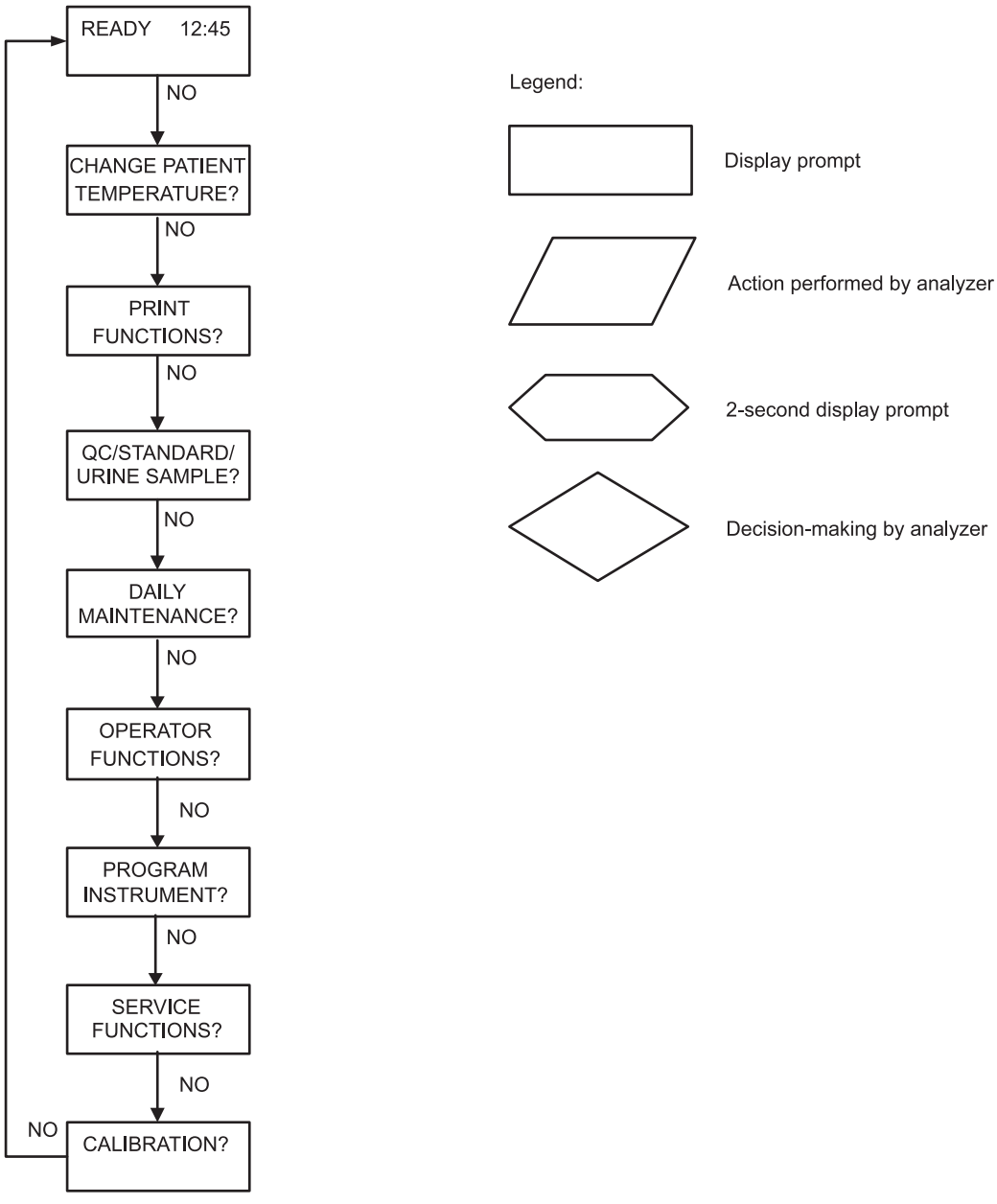


Figure B-2 9110 main menu

Measurement sequence

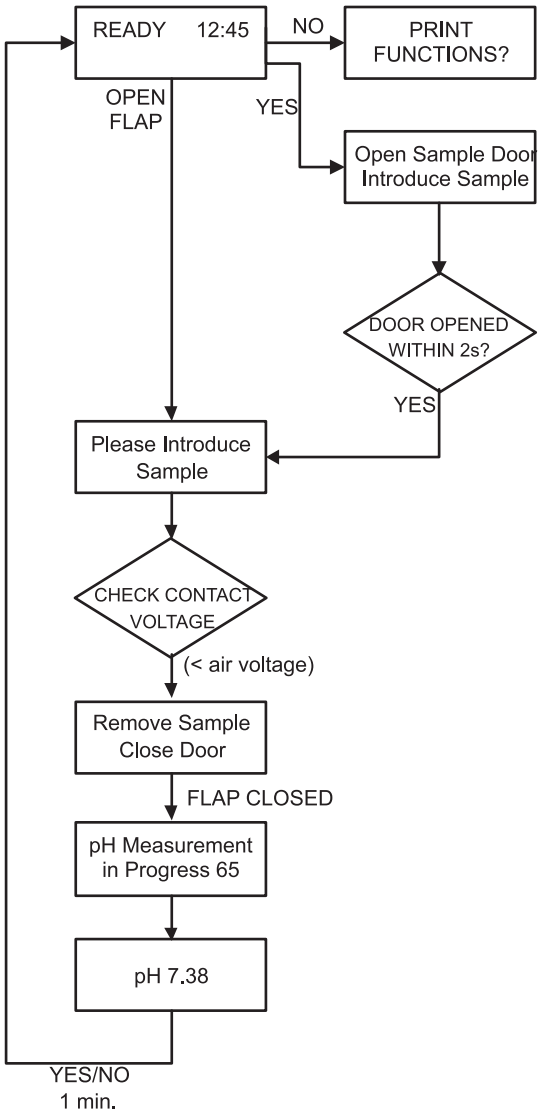


Figure B-3 9110 measurement sequence

Print functions menu

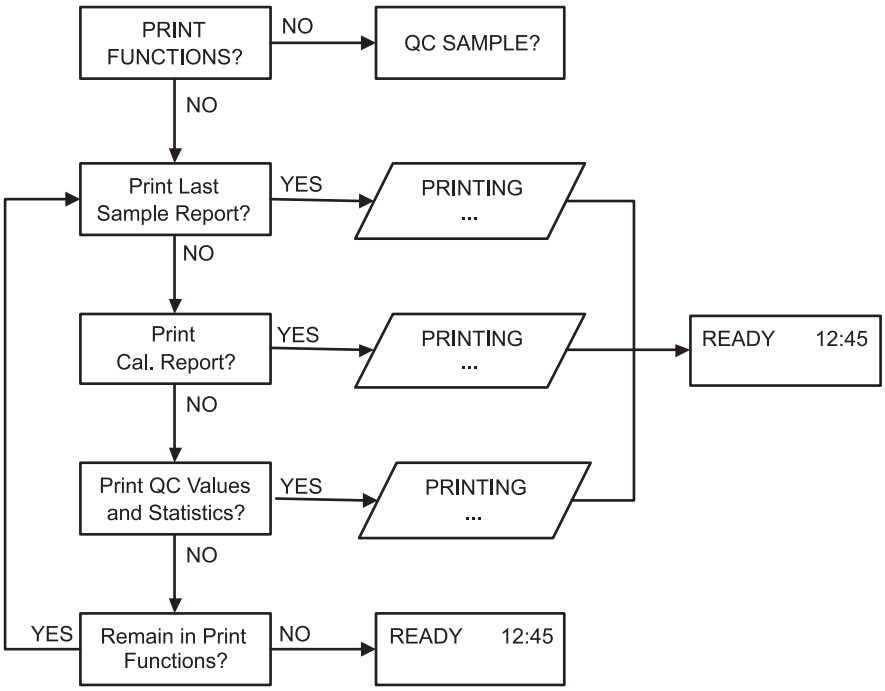


Figure B-4 9110 print functions menu

QC sample menu

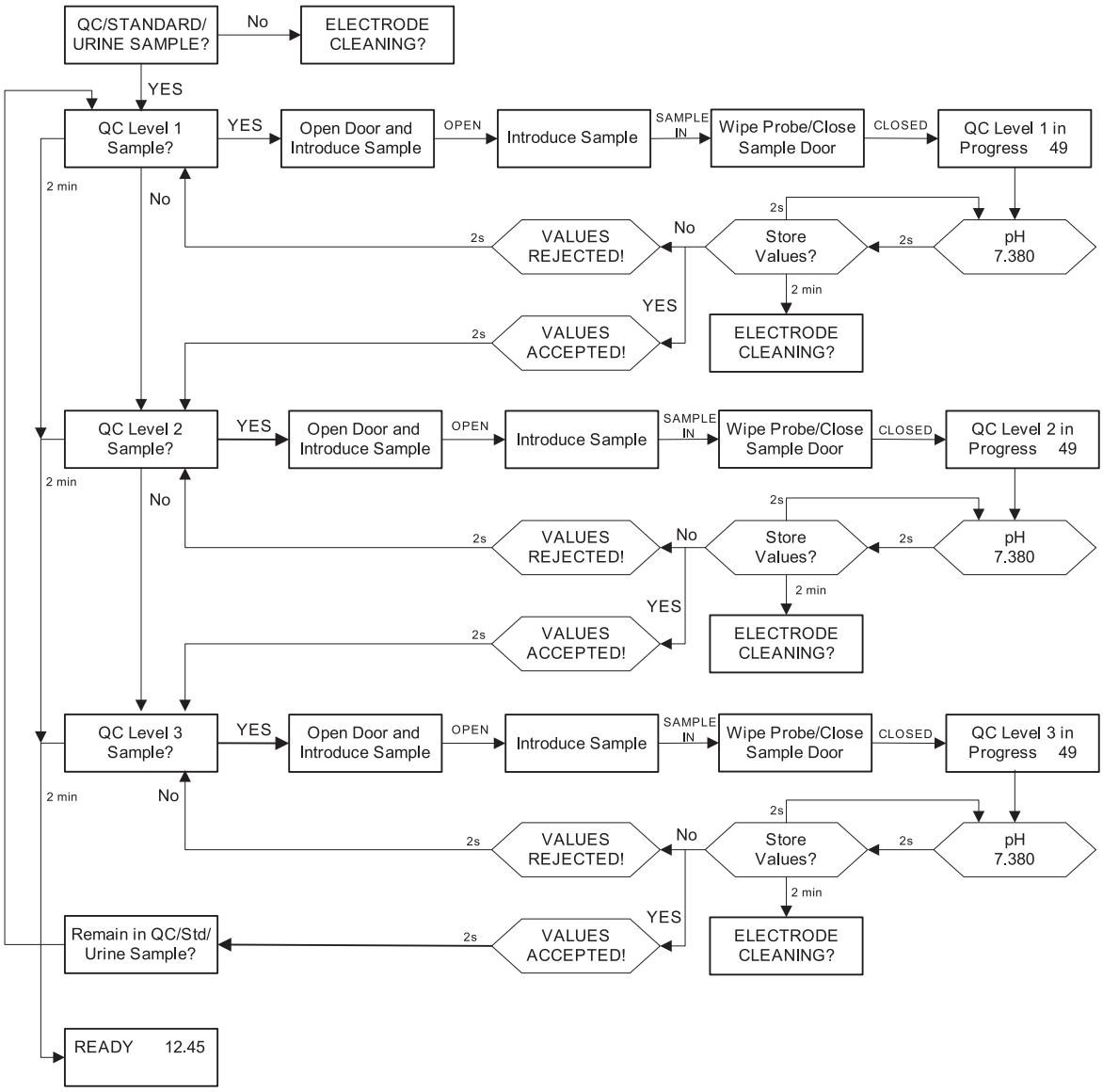


Figure B-5 9110 QC sample menu

Daily maintenance menu

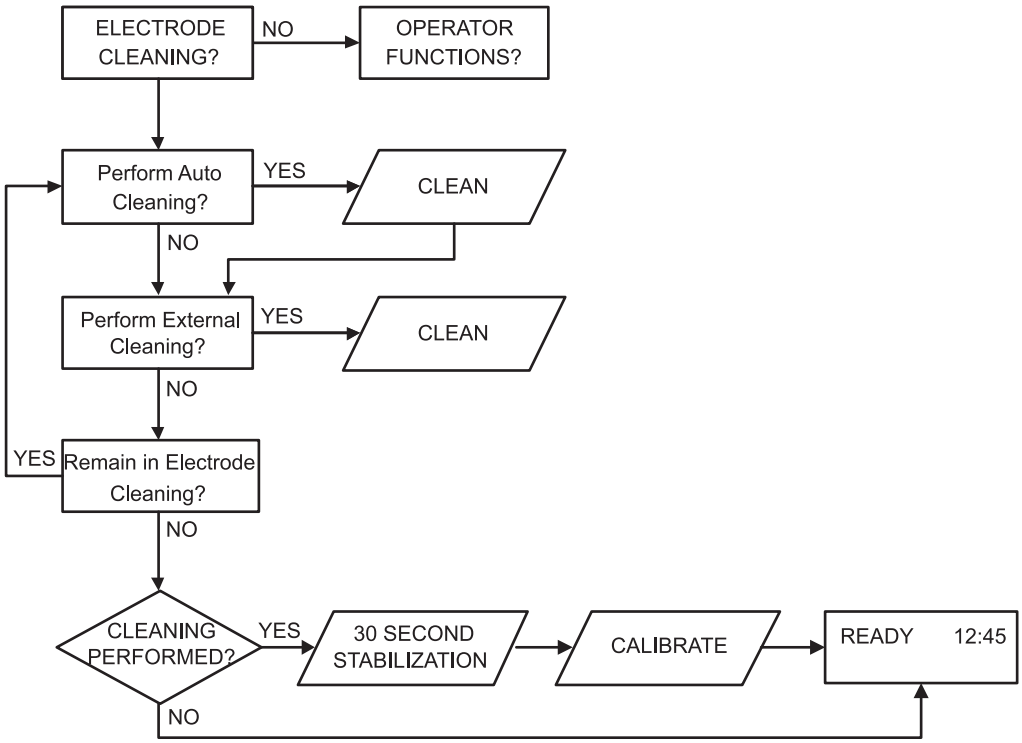


Figure B-6 9110 daily maintenance menu

Operator functions menu

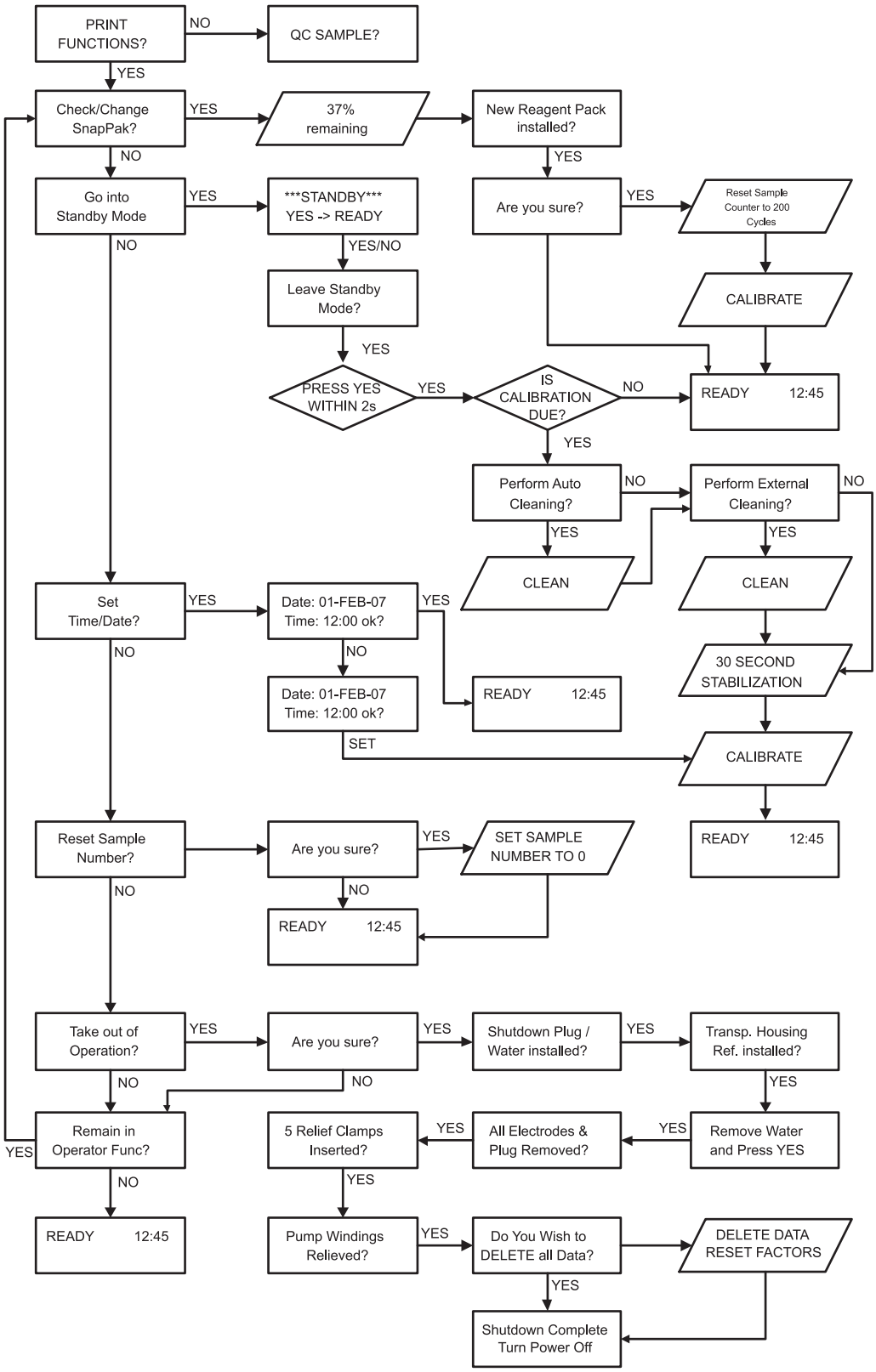


Figure B-7 9110 operator functions menu

Program instrument menu

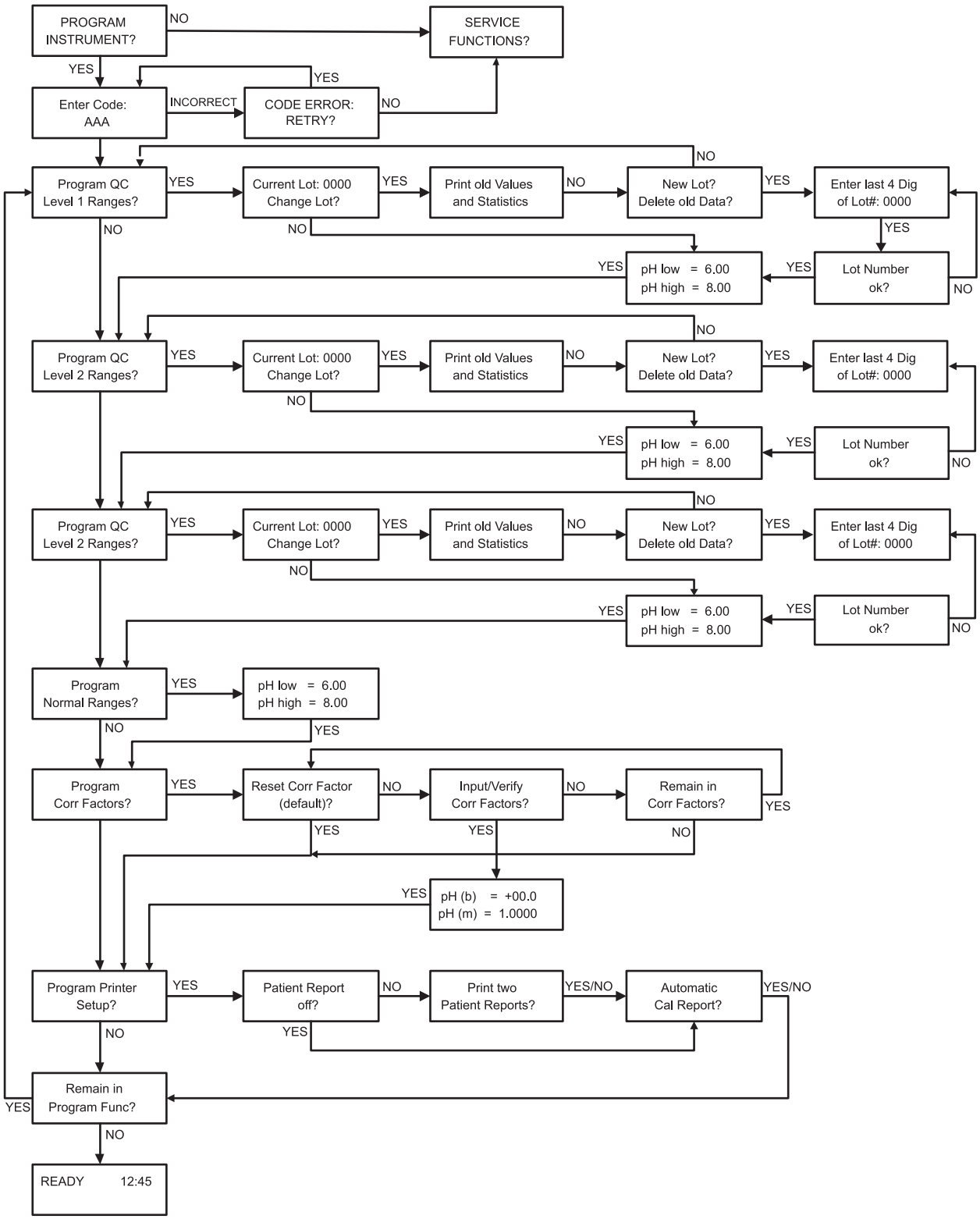


Figure B-8 9110 program instrument menu

Service functions menu

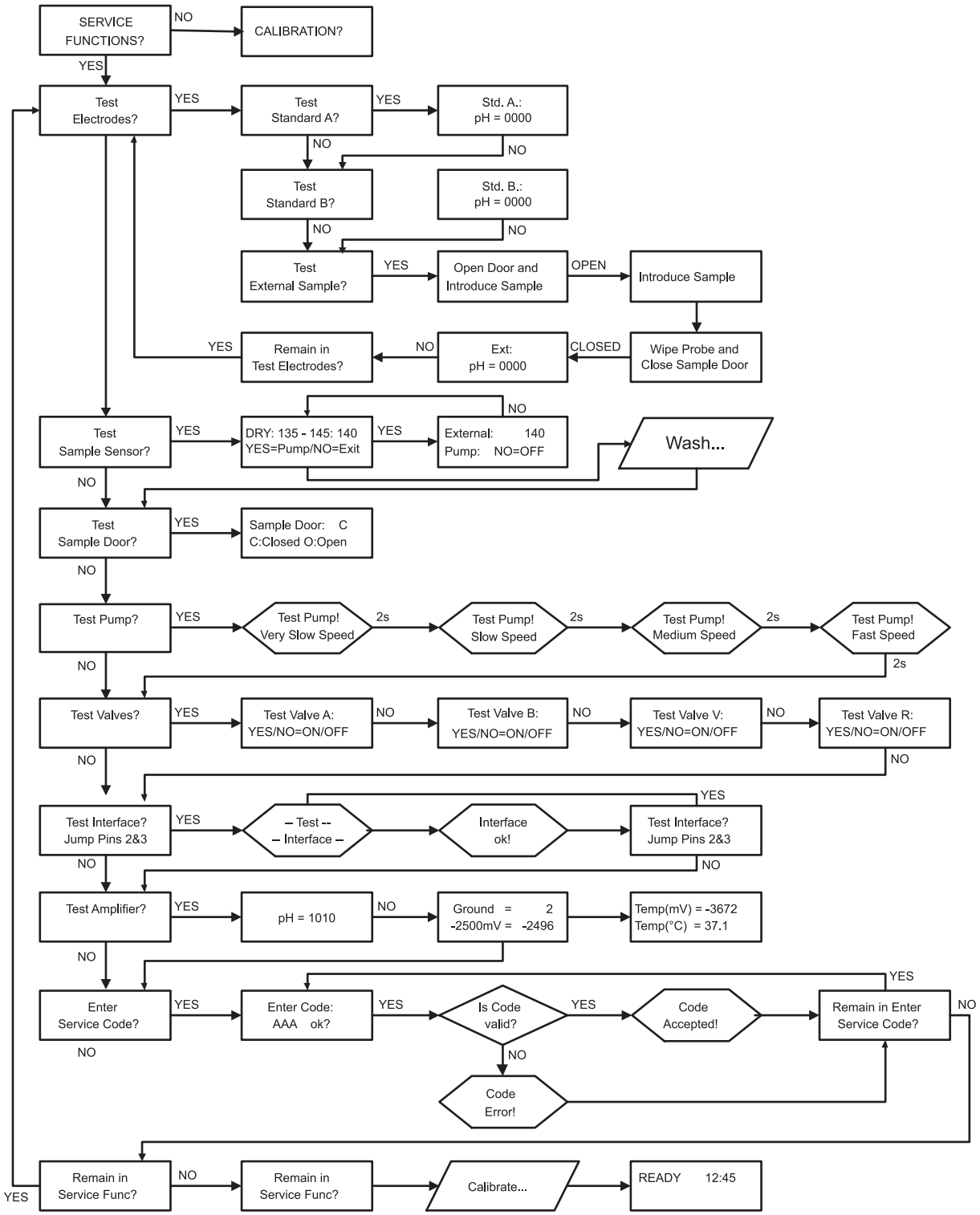


Figure B-9 9110 service functions menu

Calibration sequence

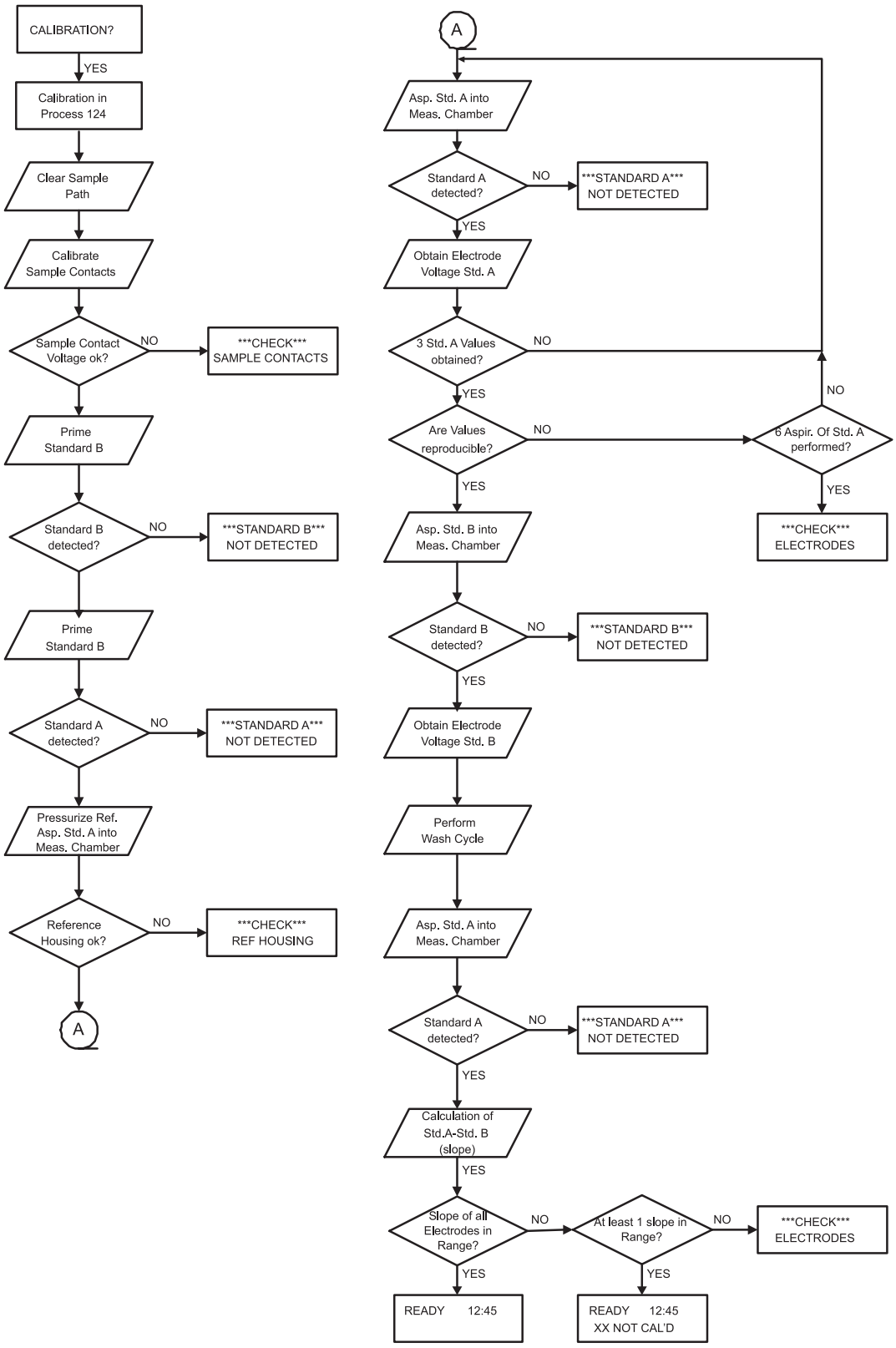


Figure B-10 9110 calibration sequence

Software operation 9120, 9130, 9140

In this chapter *Chapter* 7

Software operation 9120, 9130, 9140 ..... B-19
Overview B-19
Overall program operating flow B-20
Main menu B-21
Measurement sequence B-22
Print functions menu B-23
QC/Standard/urine sample menu B-24
Daily maintenance menu B-25
Operator functions menu B-26
Program instrument menu B-27
Service functions menu B-28
Calibration sequence B-29

Software operation 9120, 9130, 9140

Overview

1 Overall Program Operating Flow

2 Main Menu

3 Measurement Sequence

4 Print Functions Menu

5 QC/Standard/Urine Sample Menu

6 Daily Maintenance Menu

7 Operator Functions Menu

8 Program Instrument Menu

9 Service Functions Menu

10 Calibration Sequence!

Overall program operating flow

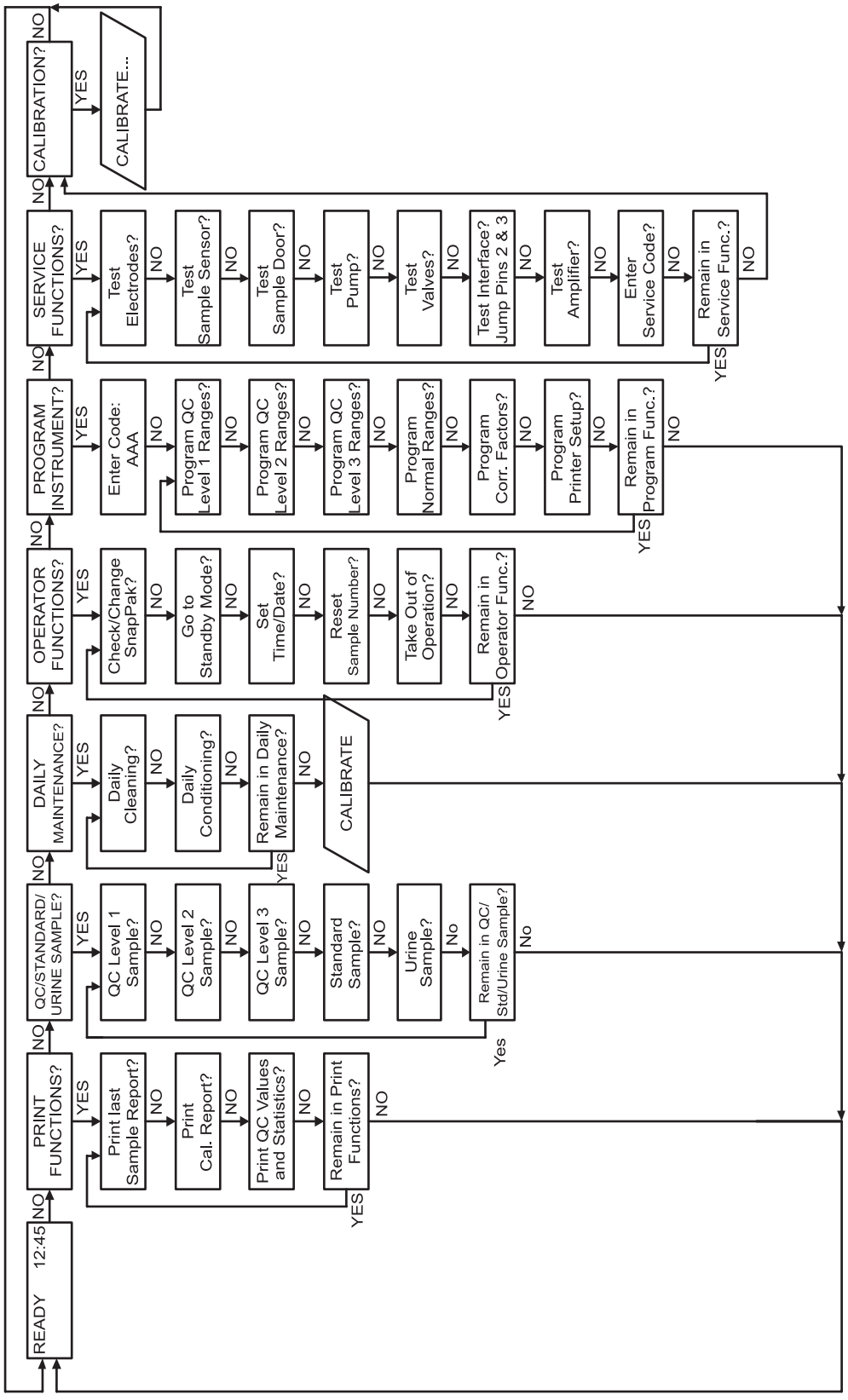


Figure B-11 9120, 9130, 9140 program flow

Main menu

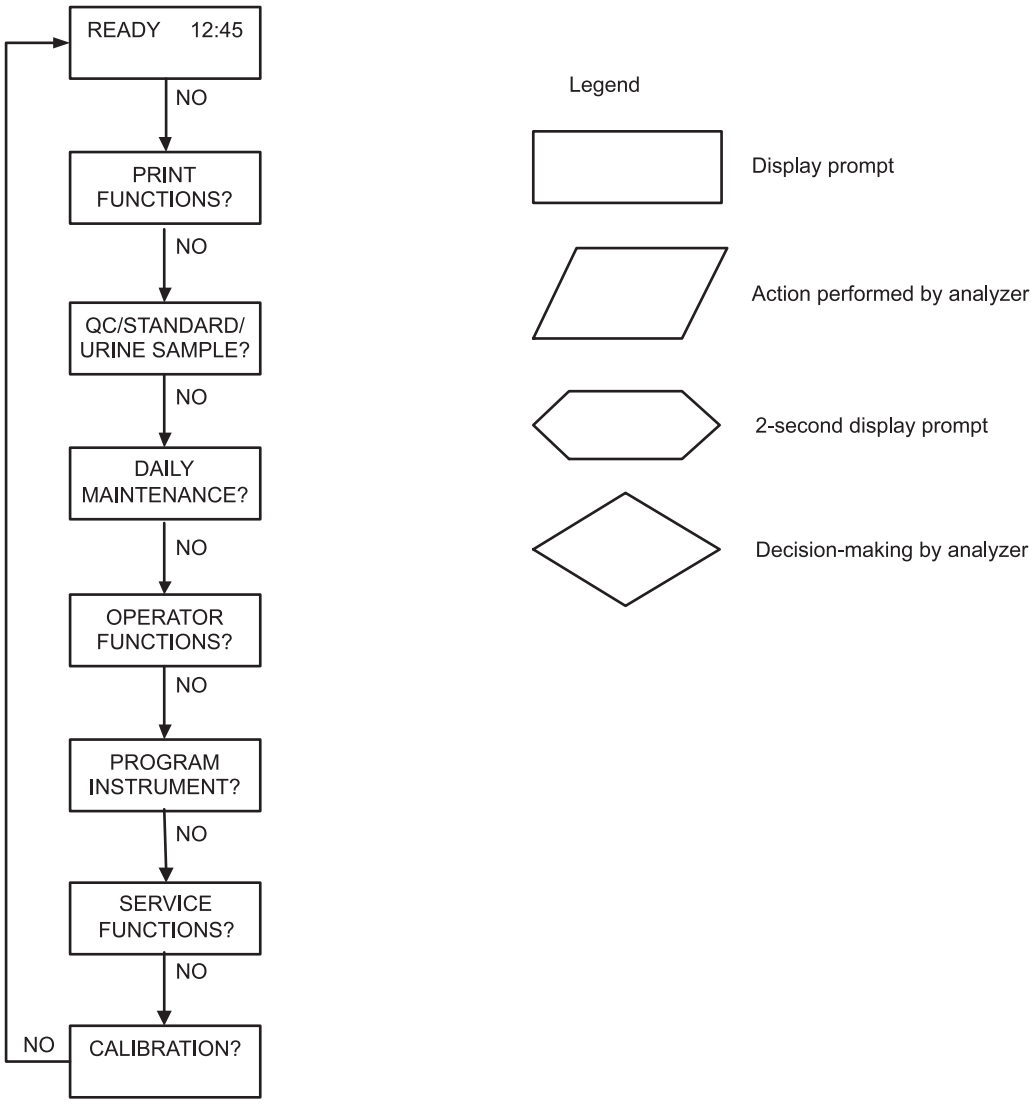


Figure B-12 9120, 9130, 9140 main menu

Measurement sequence

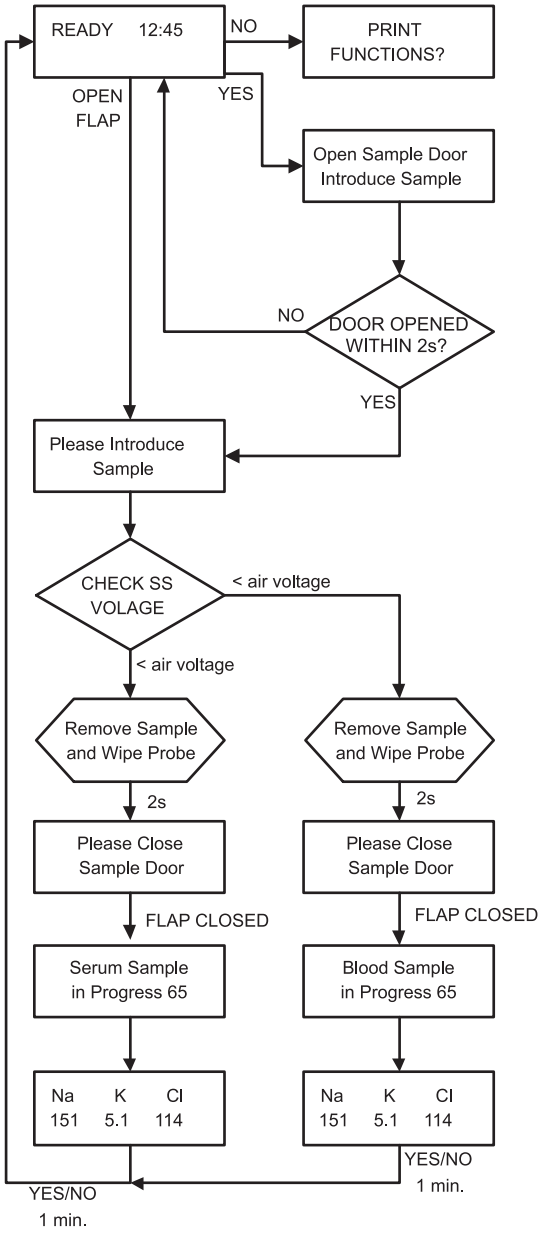


Figure B-13 9120, 9130, 9140 measurement sequence

Print functions menu

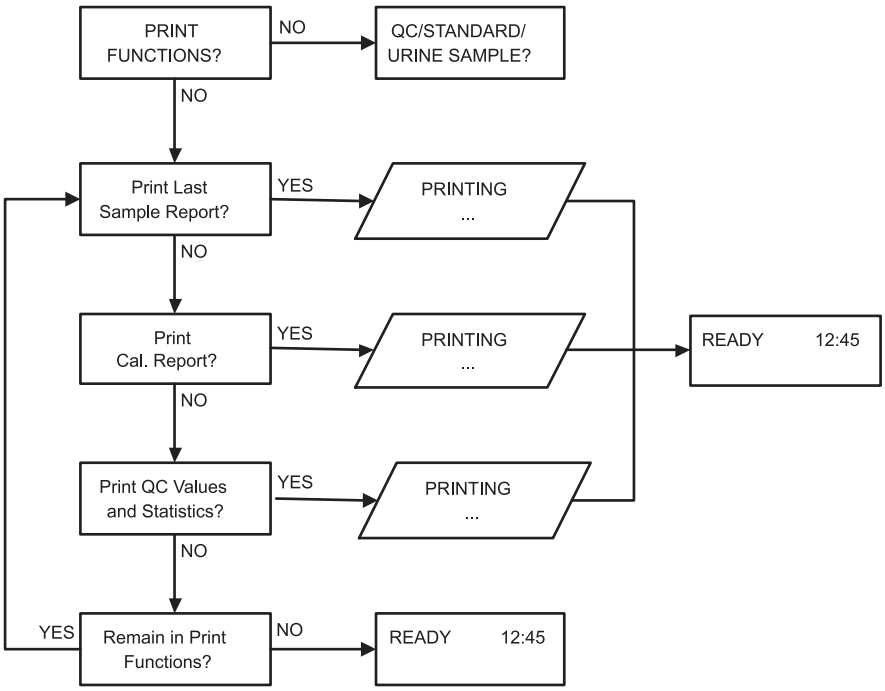


Figure B-14 9120, 9130, 9140 print functions menu

QC/standard/urine sample menu

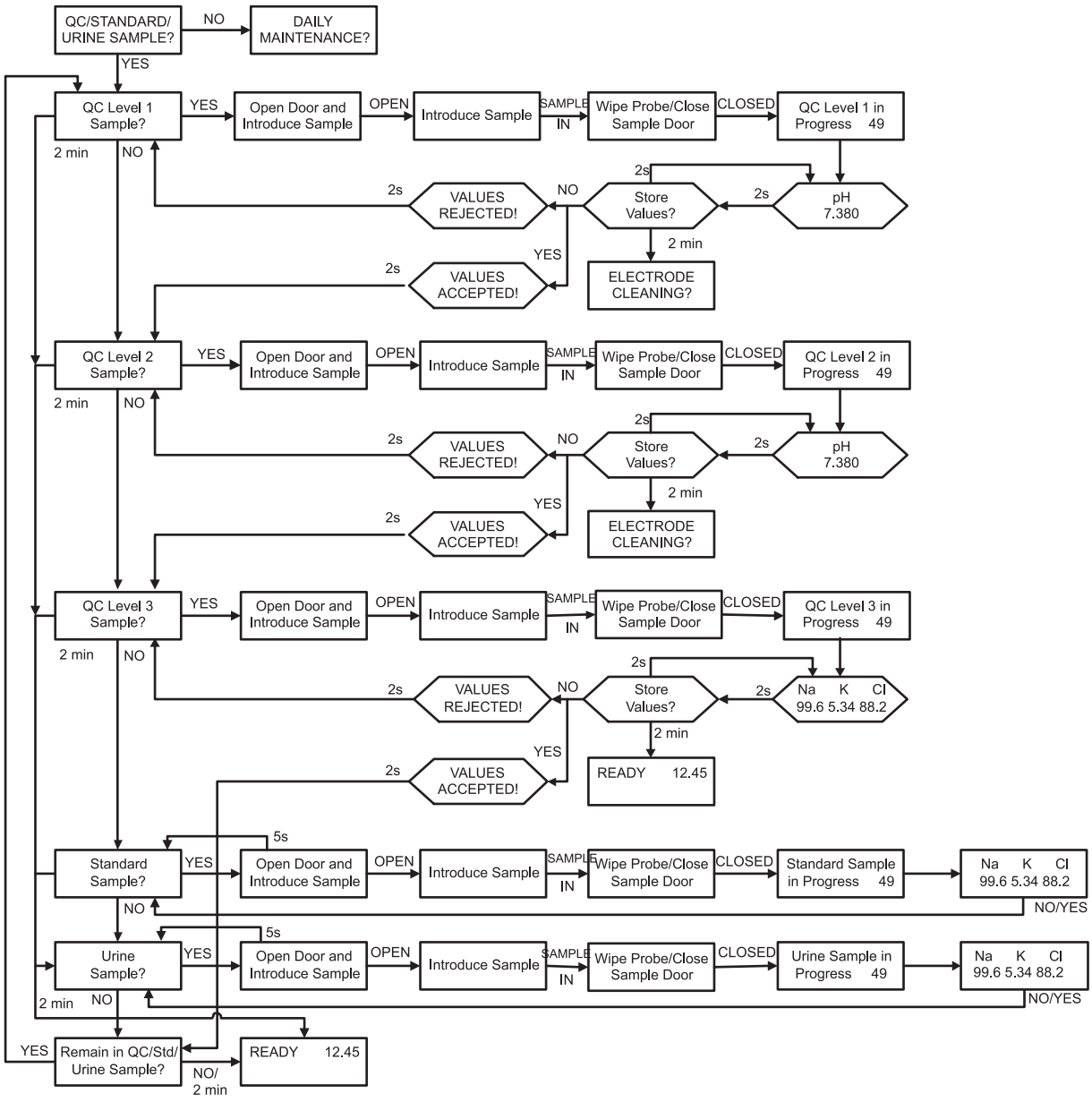


Figure B-15 9120, 9130, 9140 QC/Standard/urine sample menu

Daily maintenance menu

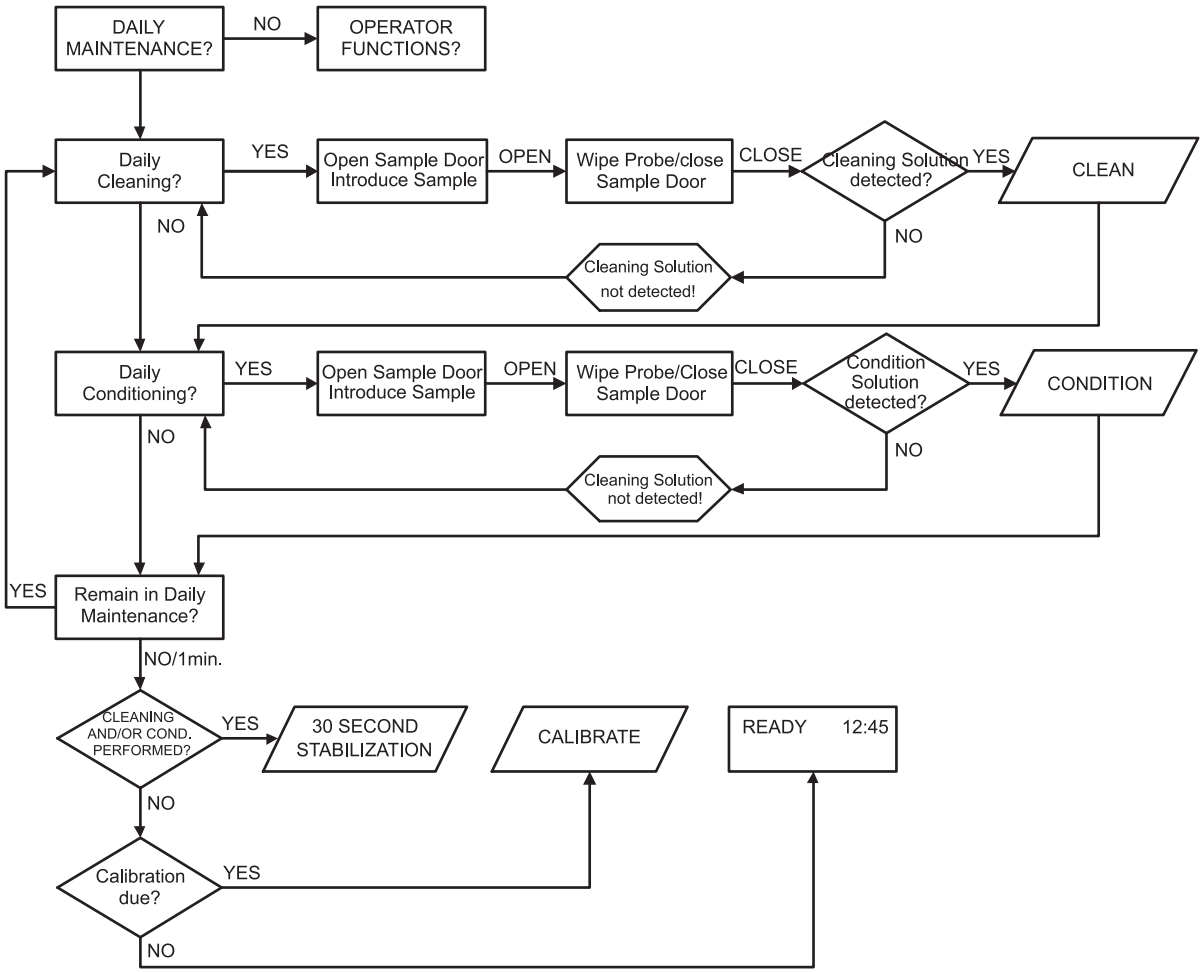


Figure B-16 9120, 9130, 9140 daily maintenance menu

Operator functions menu

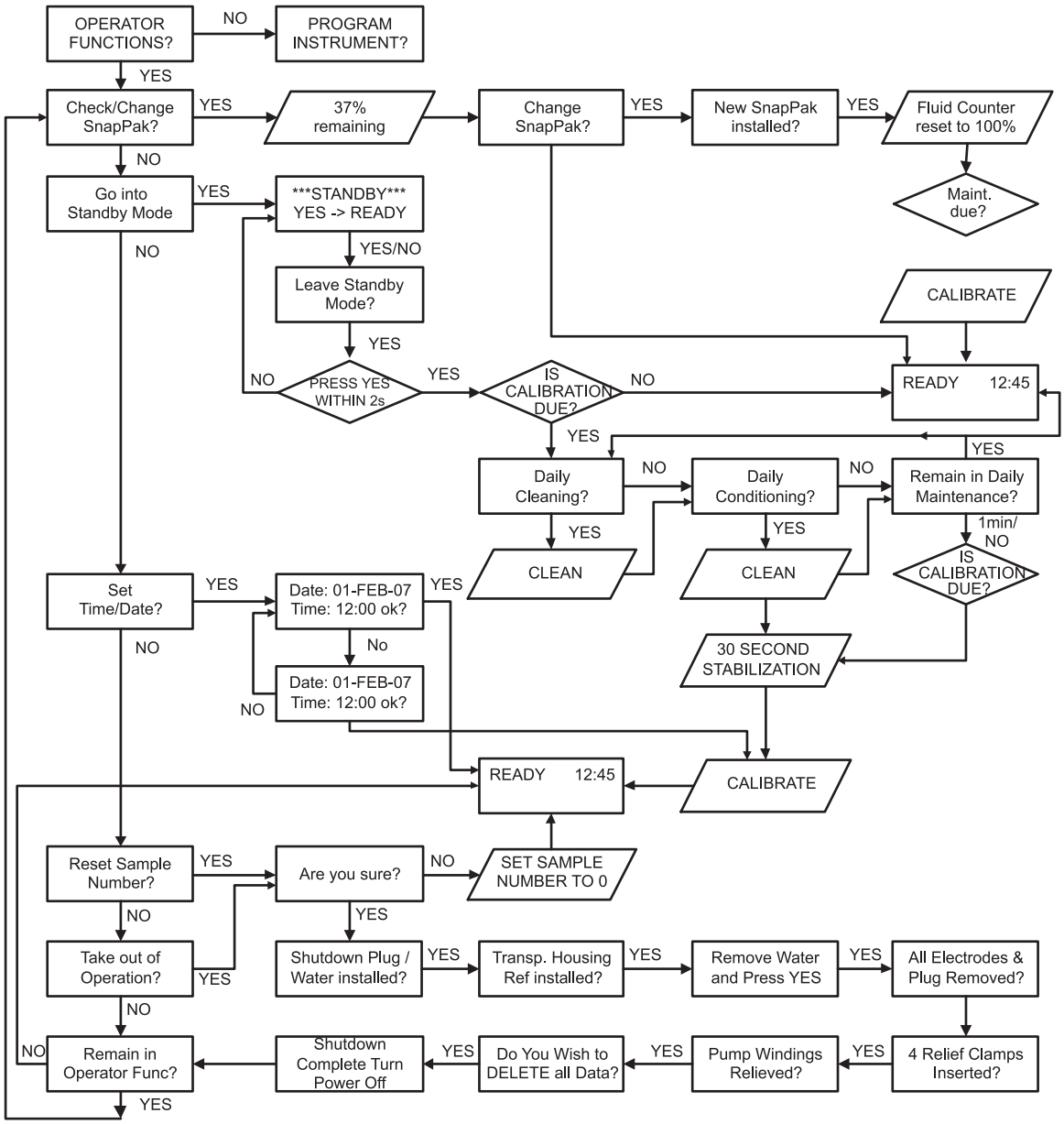


Figure B-17 9120, 9130, 9140 operator functions menu

Program instrument menu

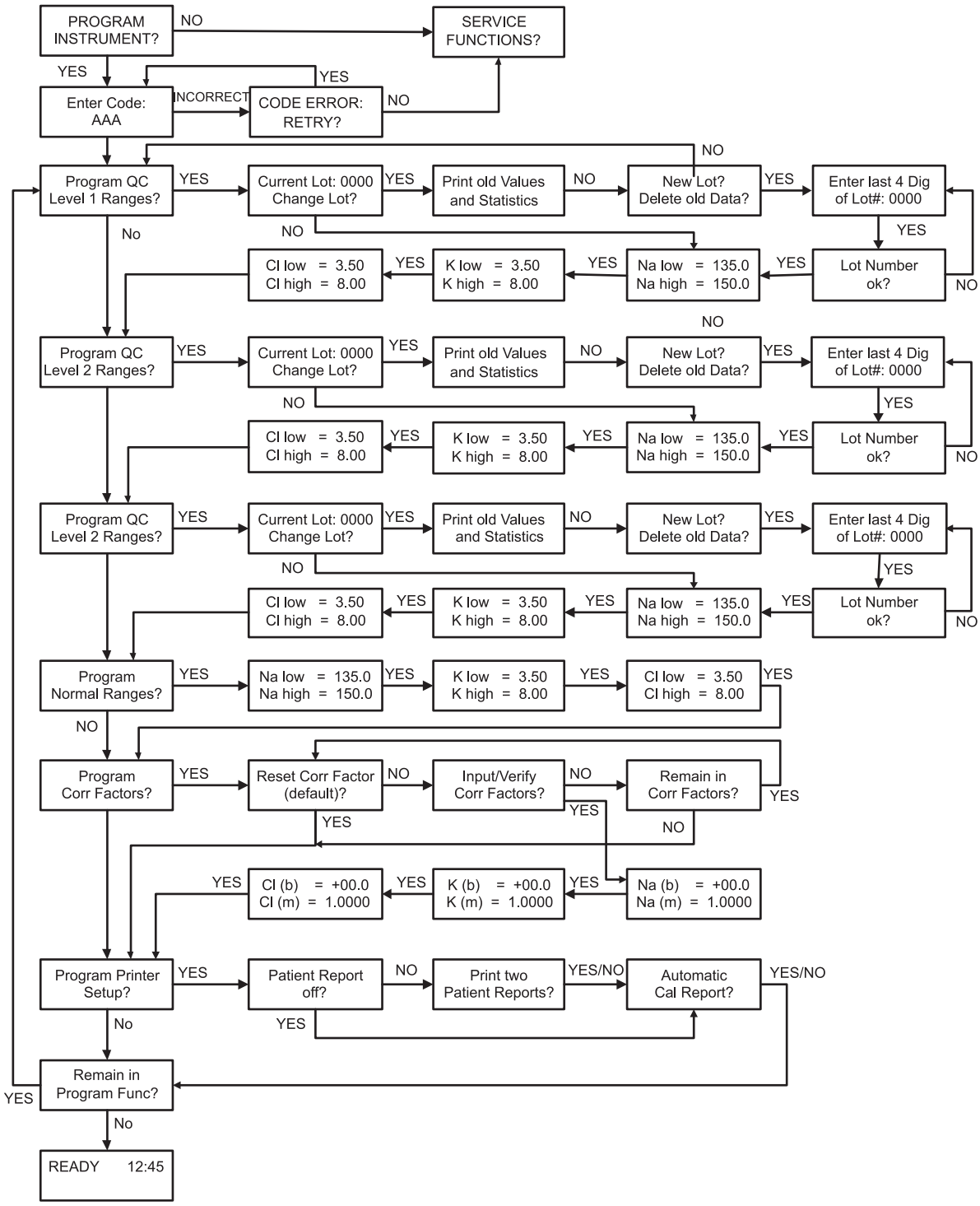


Figure B-18 9120, 9130, 9140 program instrument menu

Service functions menu

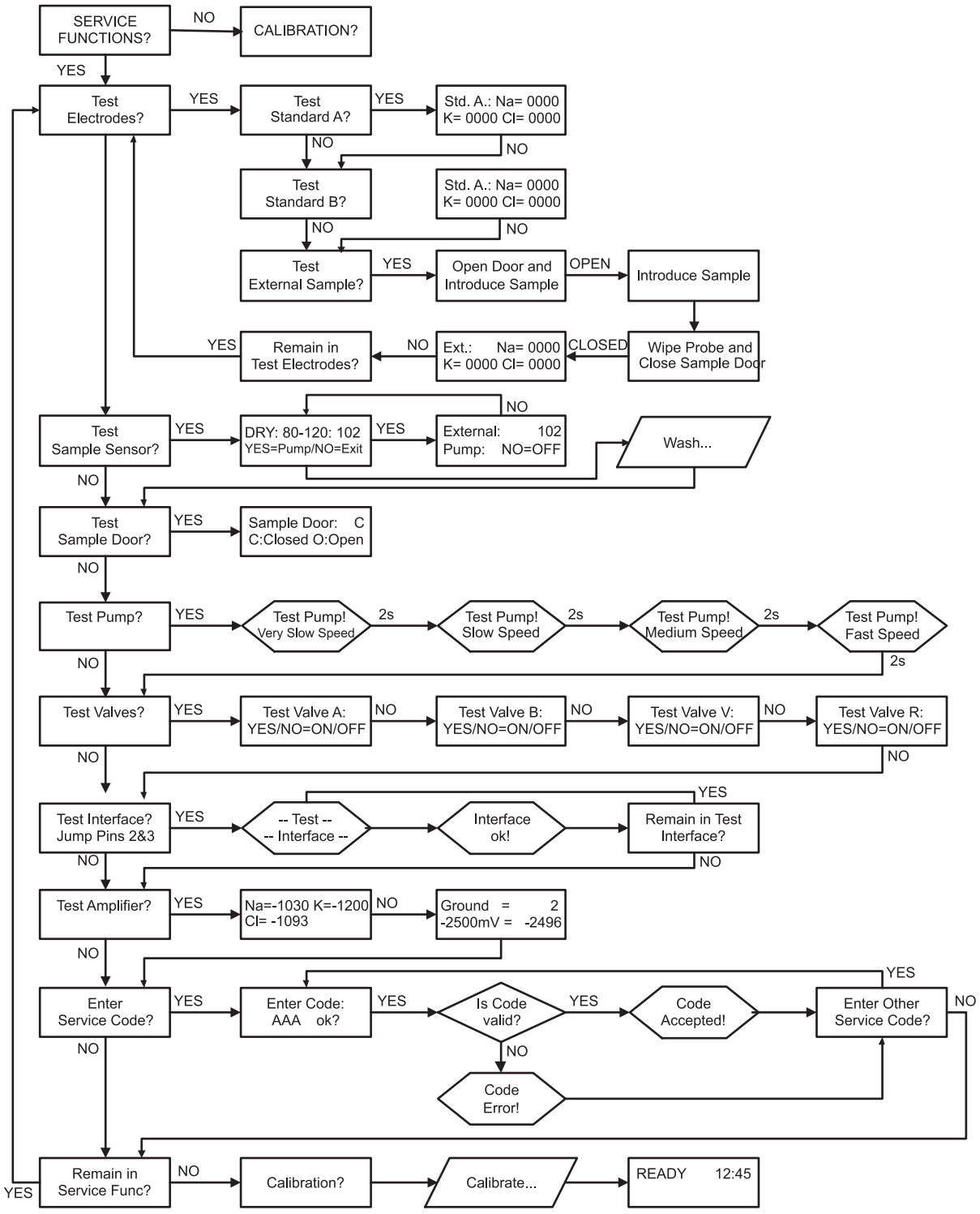


Figure B-19 9120, 9130, 9140 service functions menu

Calibration sequence

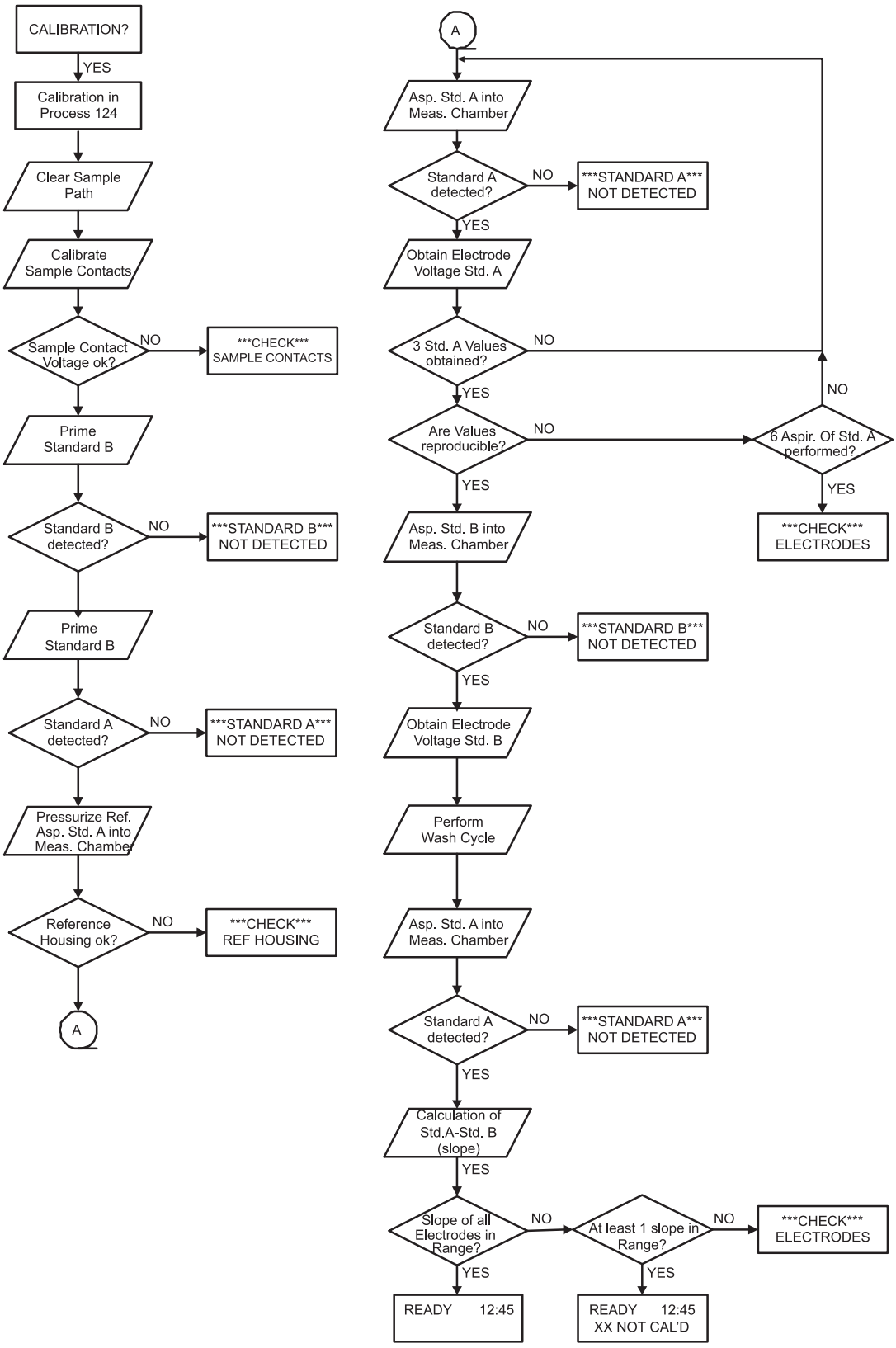


Figure B-20 9120, 9130, 9140 calibration sequence

Software operation 9180

In this chapter *Chapter* 8

Software operation 9180 ..... B-33
Overview B-33
Overall program operation flow B-34
Main menu B-35
Measurement sequence B-36
Print functions menu B-37
QC/standard/dialysate/urine sample menu B-38
Daily maintenance menu B-39
Operator functions menu B-40
Program instrument menu B-41
Service functions menu B-42
Calibration sequence (1) (Example Na/K/Li calibration) B-43
Calibration sequence (2) (Example Na/K/Li calibration) B-44
Power-up B-45

Software operation 9180

Overview

1 Overall Program Operating Flow

2 Main Menu

3 Measurement Sequence

4 Print Functions Menu

5 QC/Std/Dialysate/Urine Sample Menu

6 Daily Maintenance Menu

7 Operator Functions Menu

8 Program Instrument Menu

9 Service Functions Menu

10 Calibration Sequence

11 Power-up Sequence

Overall program operation flow

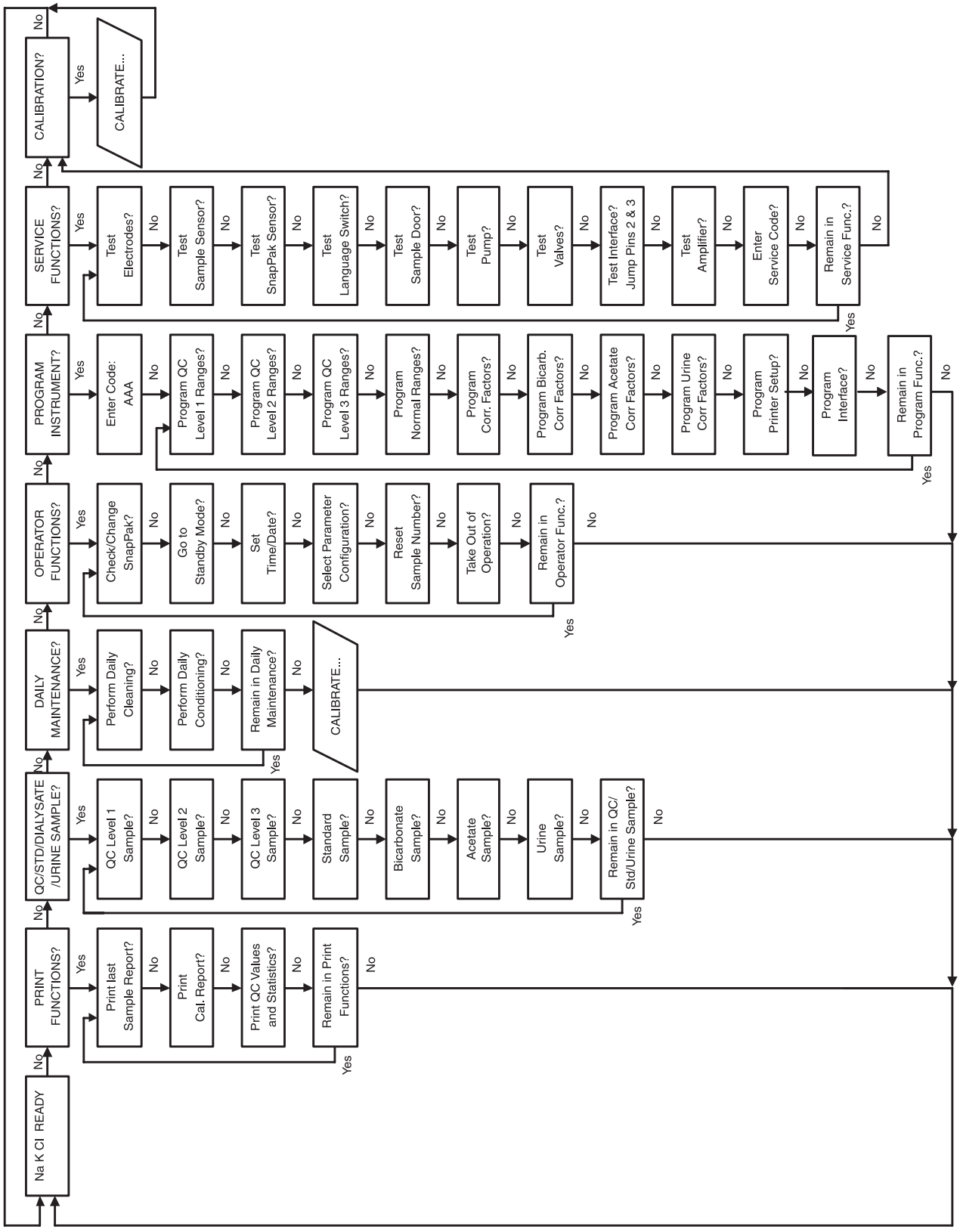


Figure B-21 9180 program flow

Main menu

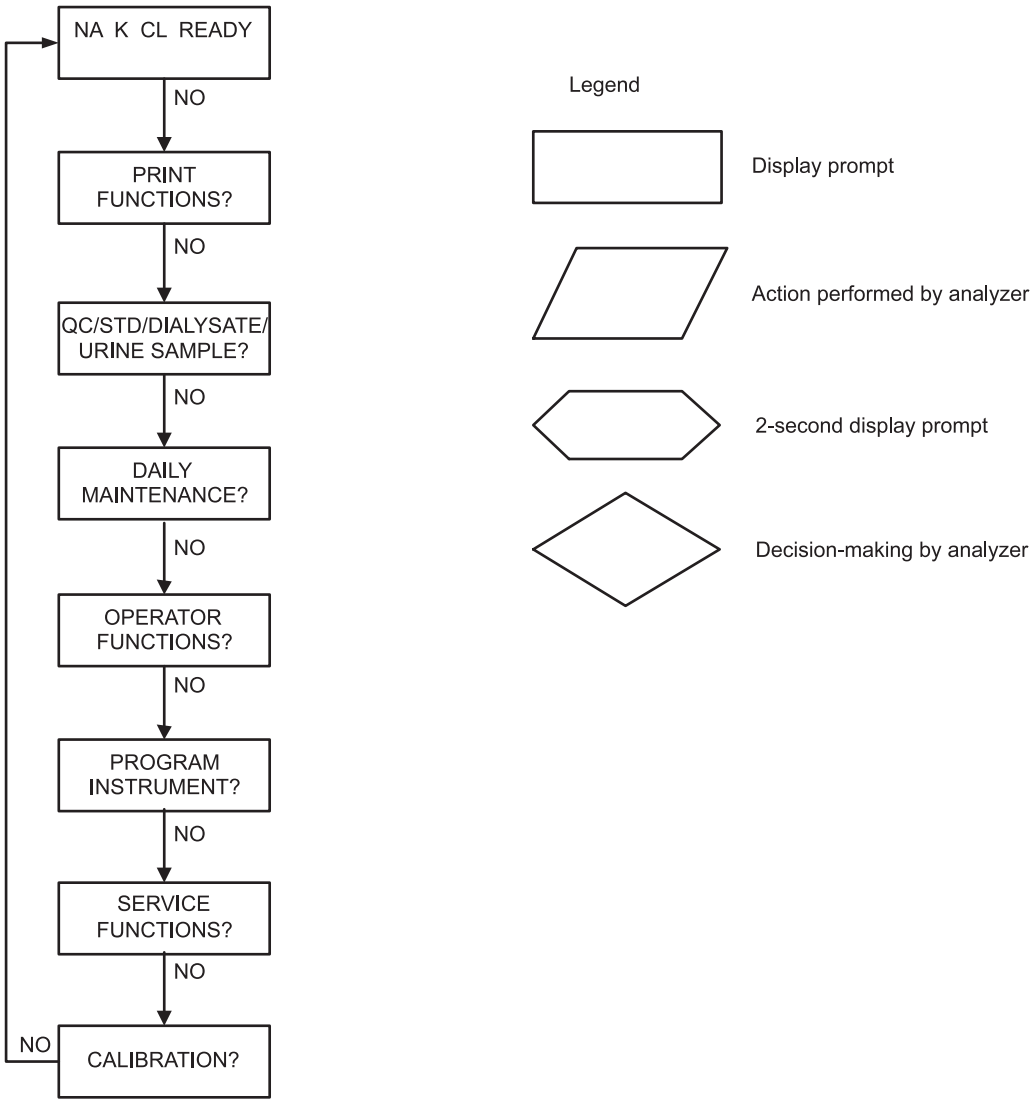


Figure B-22 9180 main menu

Measurement sequence

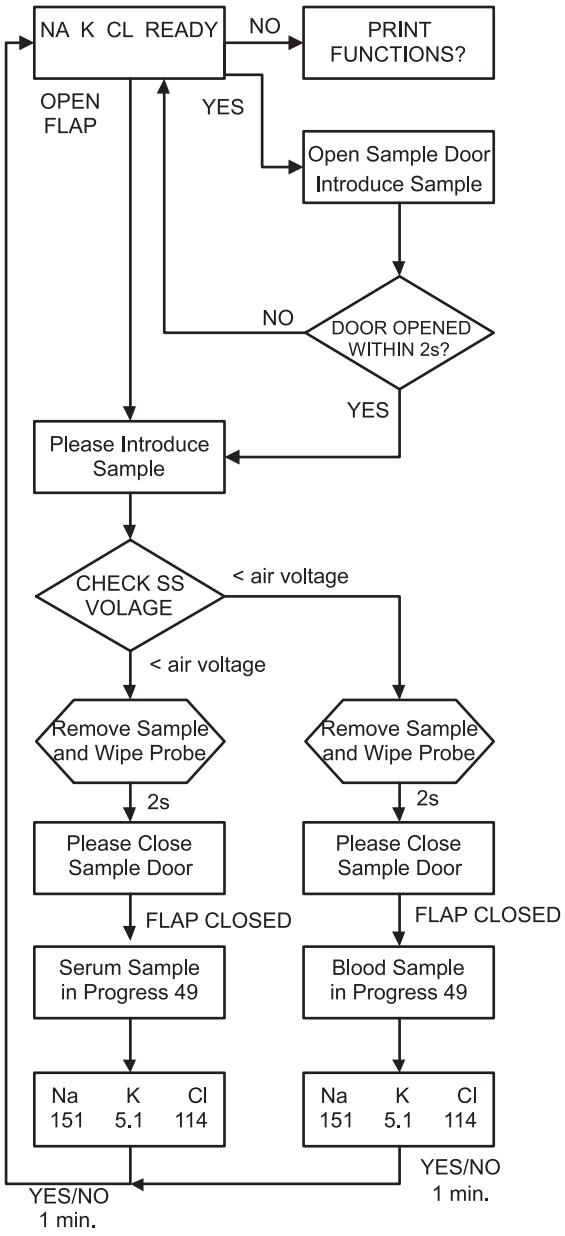


Figure B-23 9180 measurement sequence

Print functions menu

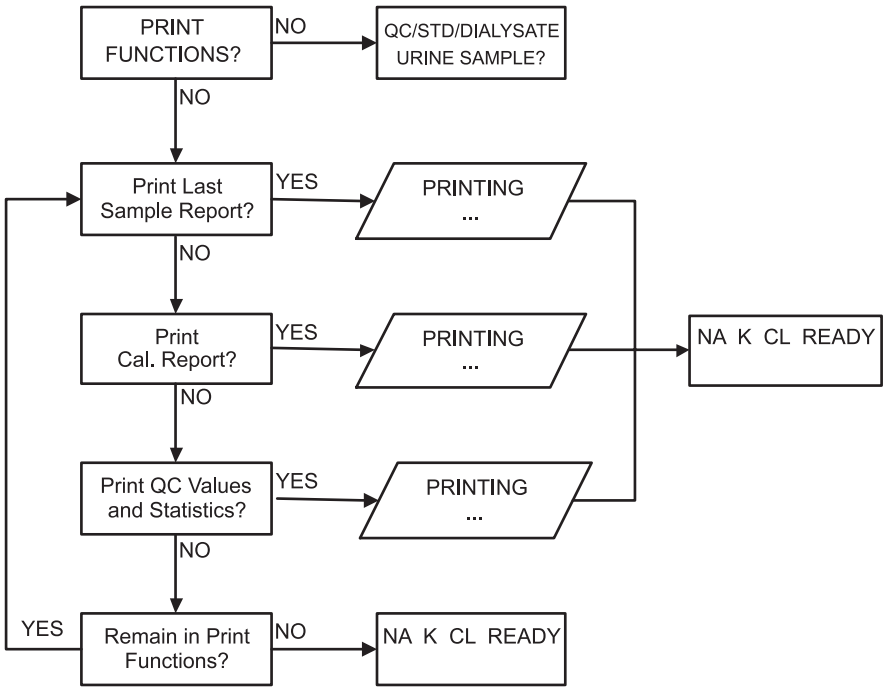


Figure B-24 9180 print functions menu

QC/standard/dialysate/urine sample menu

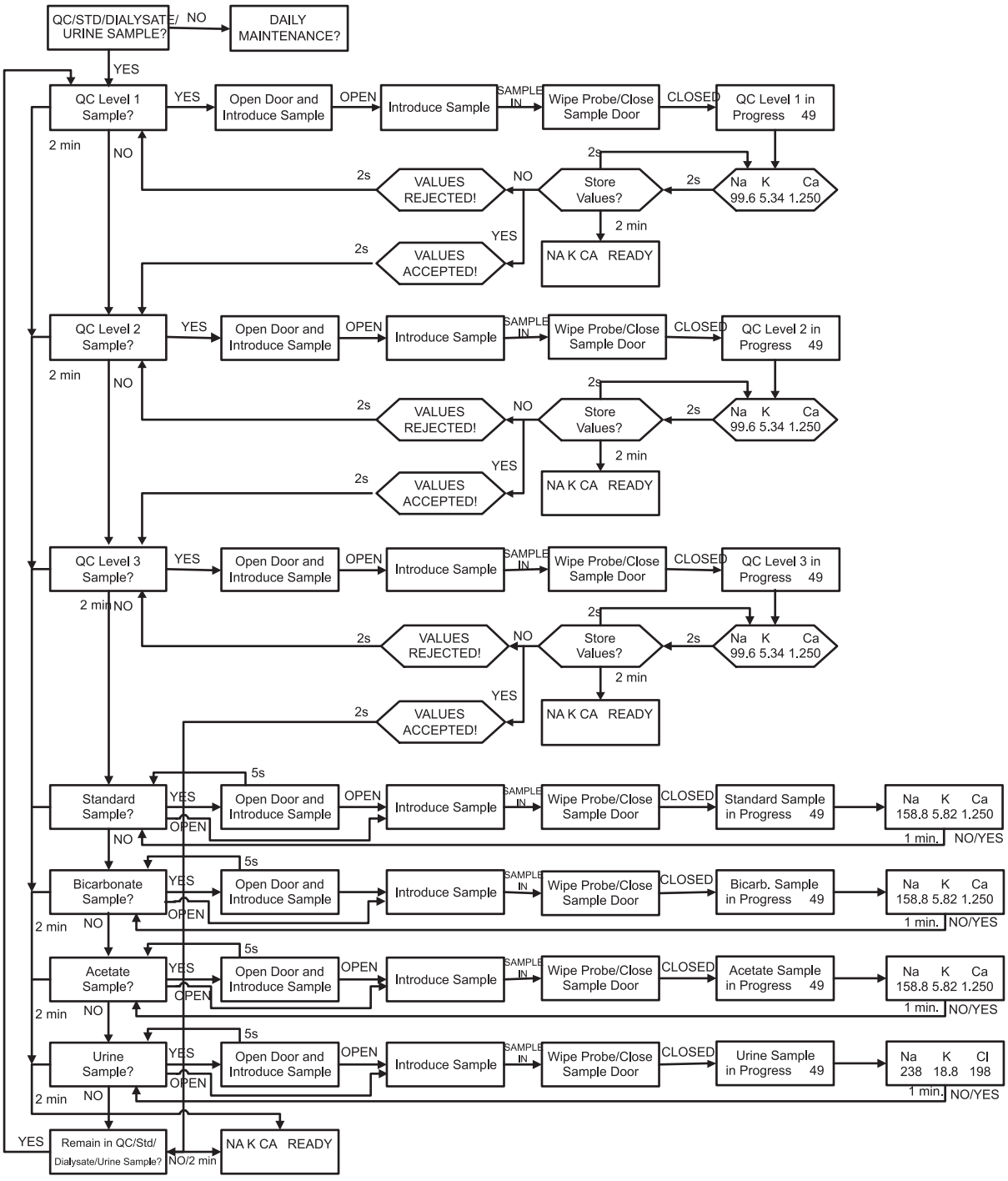


Figure B-25 9180 QC/standard/dialysate/urine sample menu

Daily maintenance menu

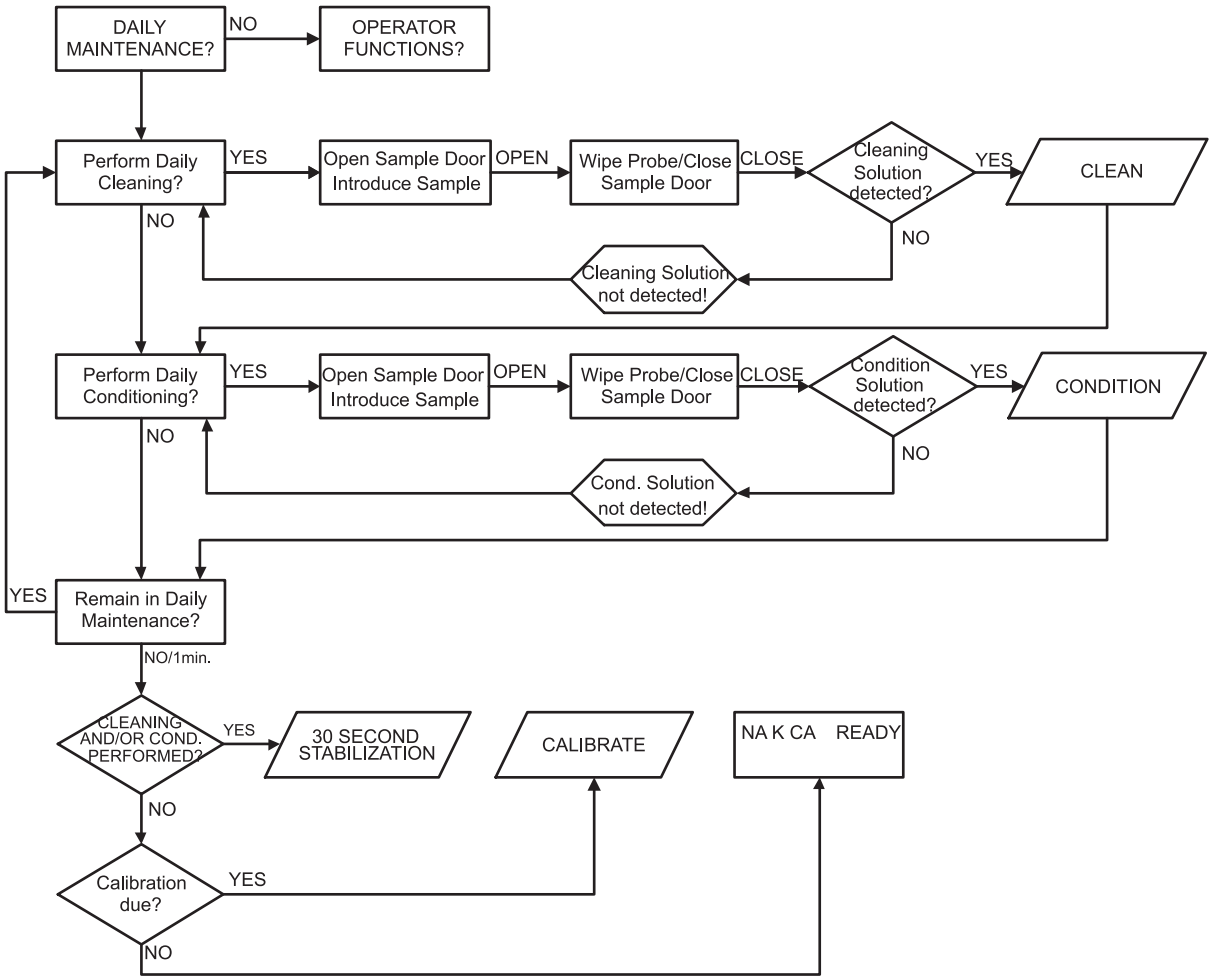


Figure B-26 9180 daily maintenance menu

Operator functions menu

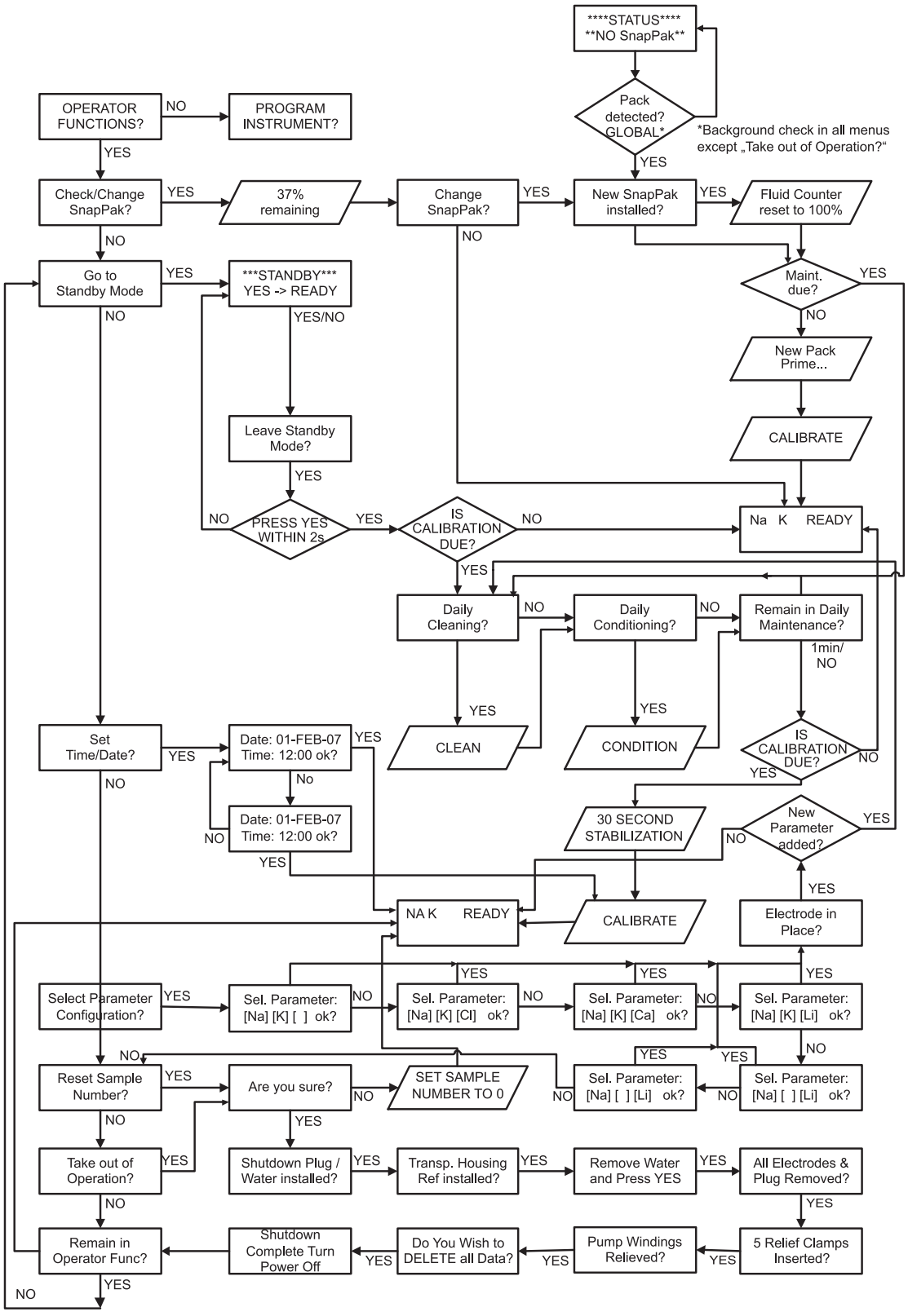


Figure B-27 9180 operator functions menu

Program instrument menu

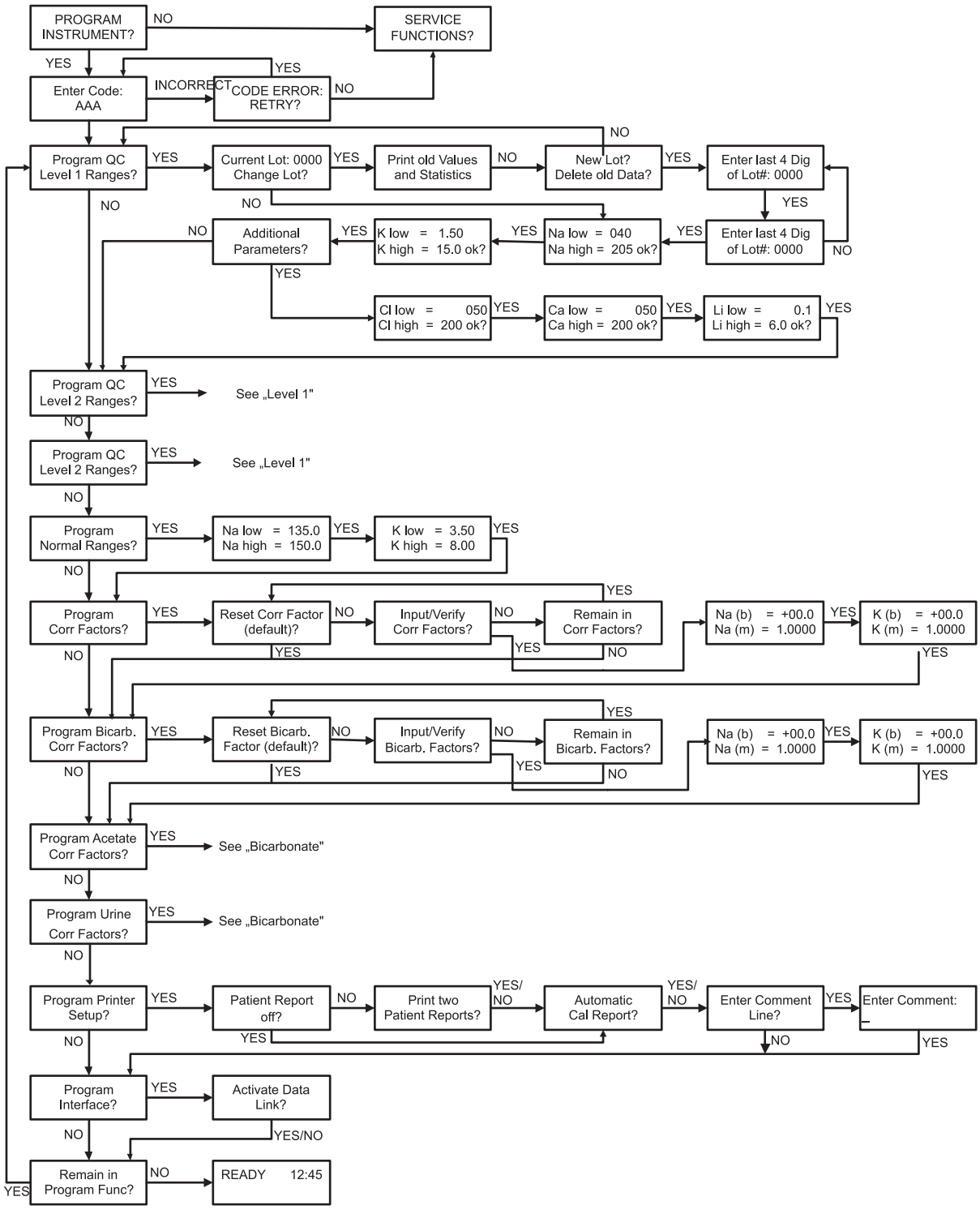


Figure B-28 9180 program instrument menu

Service functions menu

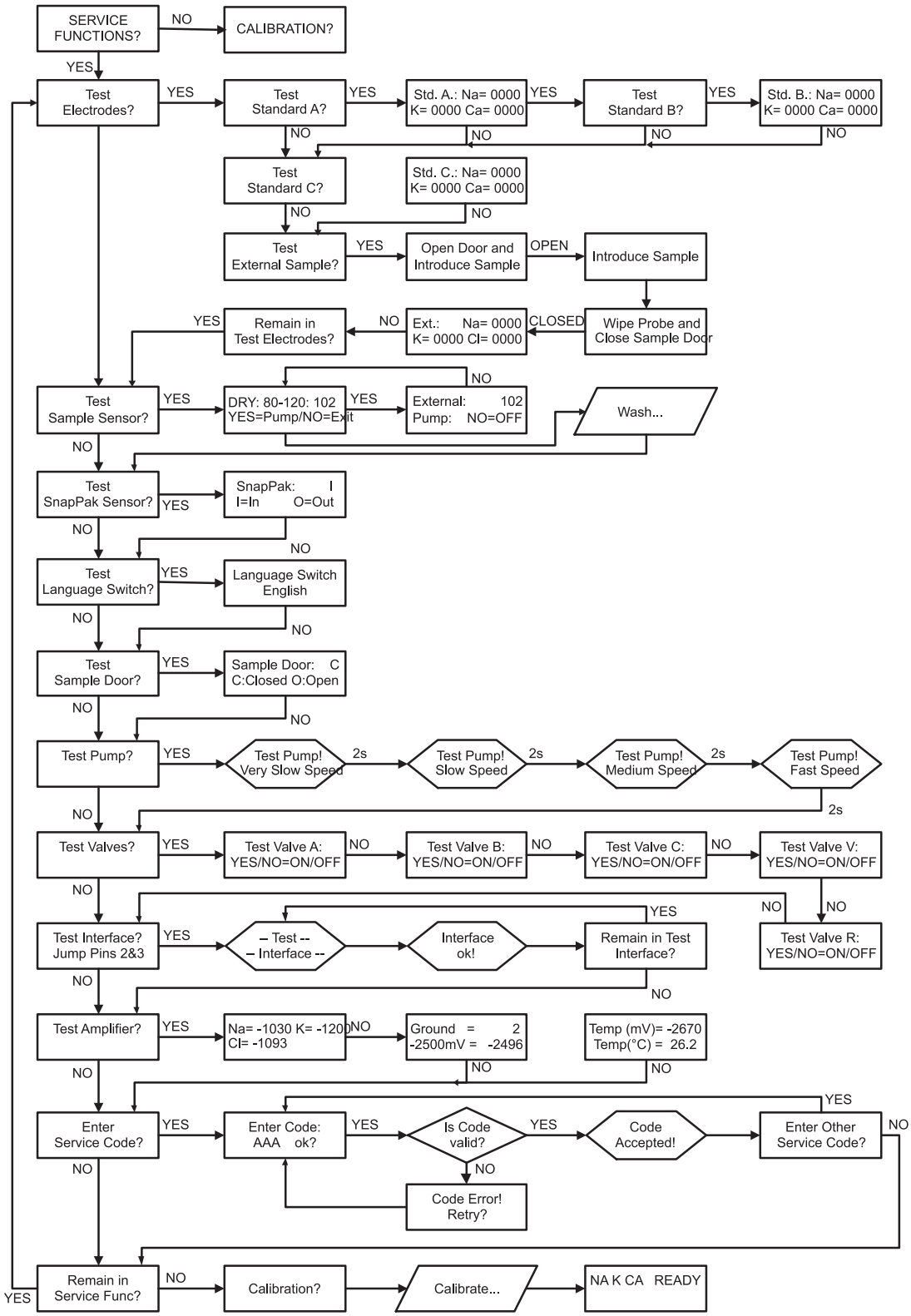


Figure B-29 9180 service functions menu

Calibration sequence (1) (Example Na/K/Li calibration)

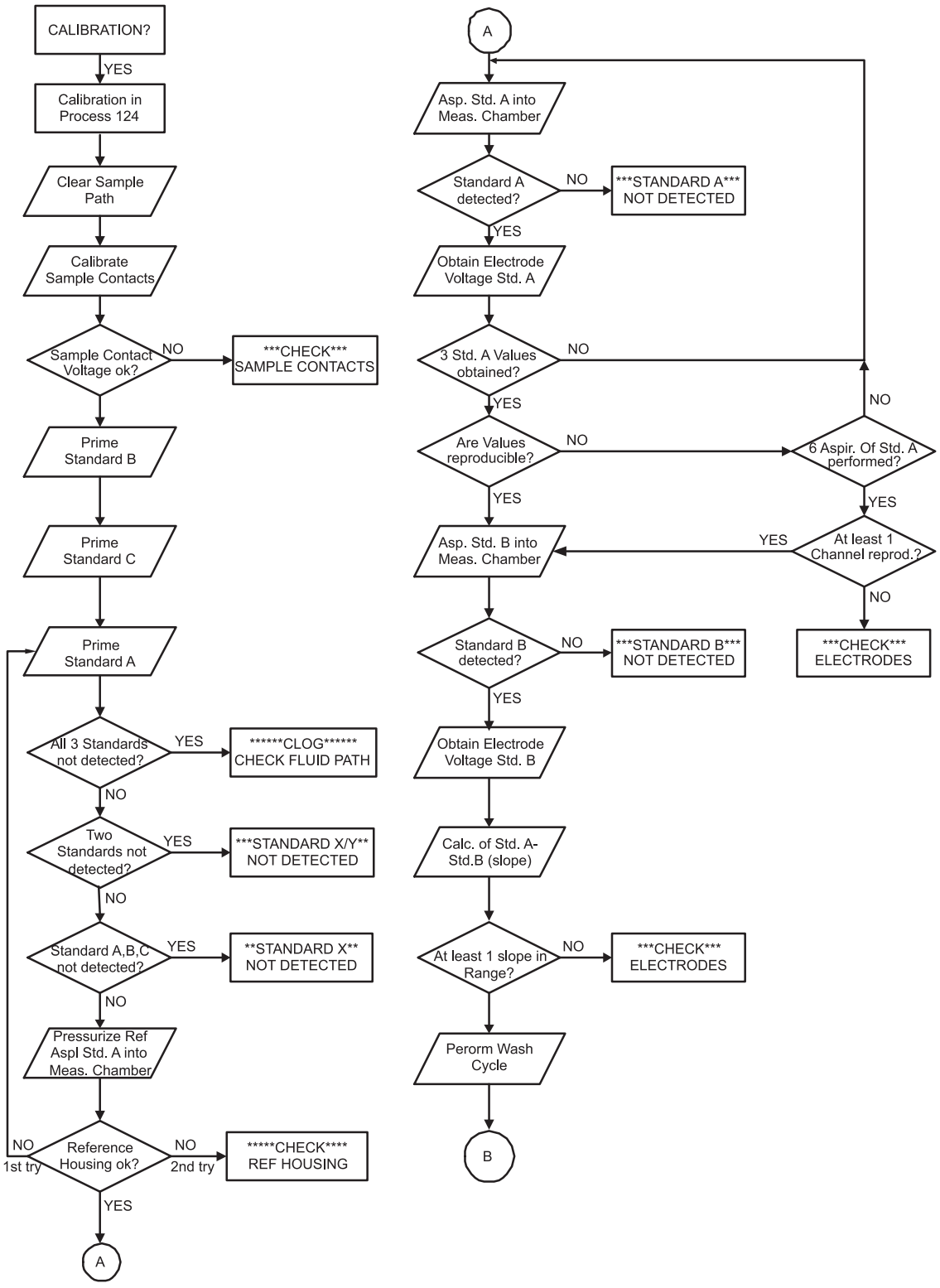


Figure B-30 9180 calibration sequence (1) (Example Na/K/Li calibration)

Calibration sequence (2) (Example Na/K/Li calibration)

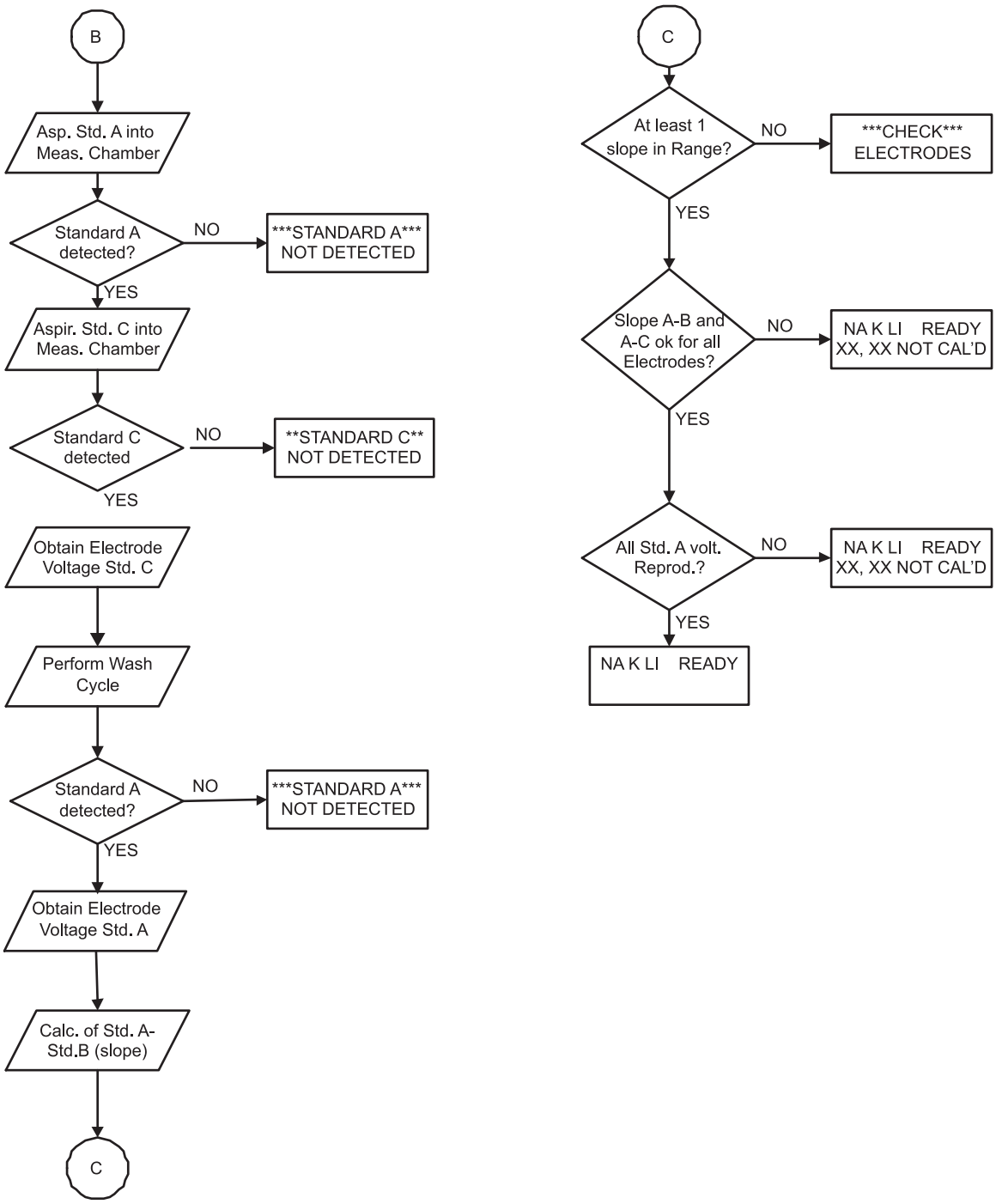


Figure B-31 9180 calibration sequence (2) (Example Na/K/Li calibration)

Power-up

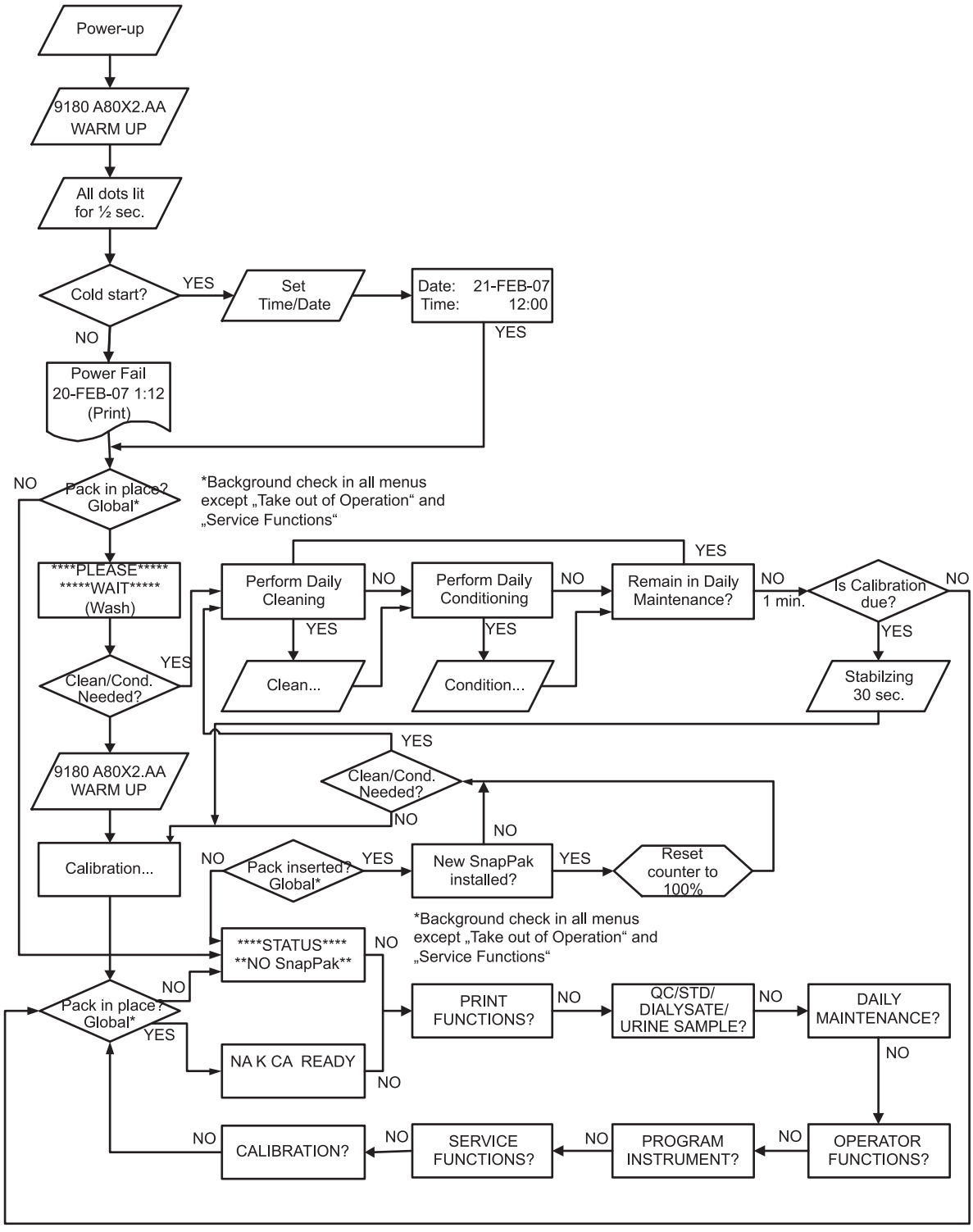


Figure B-32 9180 power-up

Software operation 9181

In this chapter *Chapter* 9

Software operation 9181 ..... B-49
Overview B-49
Overall program operting flow B-50
Main menu B-51
Manual measurement sequence B-52
Automated measurement sequence B-53
Print functions menu B-54
QC/std/dialysate/urine sample menu B-55
Daily maintenance menu B-56
Operator functions menu B-57
Program instrument menu B-58
Service functions menu B-59
Calibration sequence (1) (example Na/K/Li calibration) B-60
Calibration sequence (2) (example Na/K/Li calibration) B-61
Power-up sequence B-62

Table of contents

Software operation 9181

Overview

1 Overall Program Operating Flow

2 Main Menu

3 Measurement Sequence

4 Print Functions Menu

5 QC/Std/Dialysate/Urine Sample Menu

6 Daily Maintenance Menu

7 Operator Functions Menu

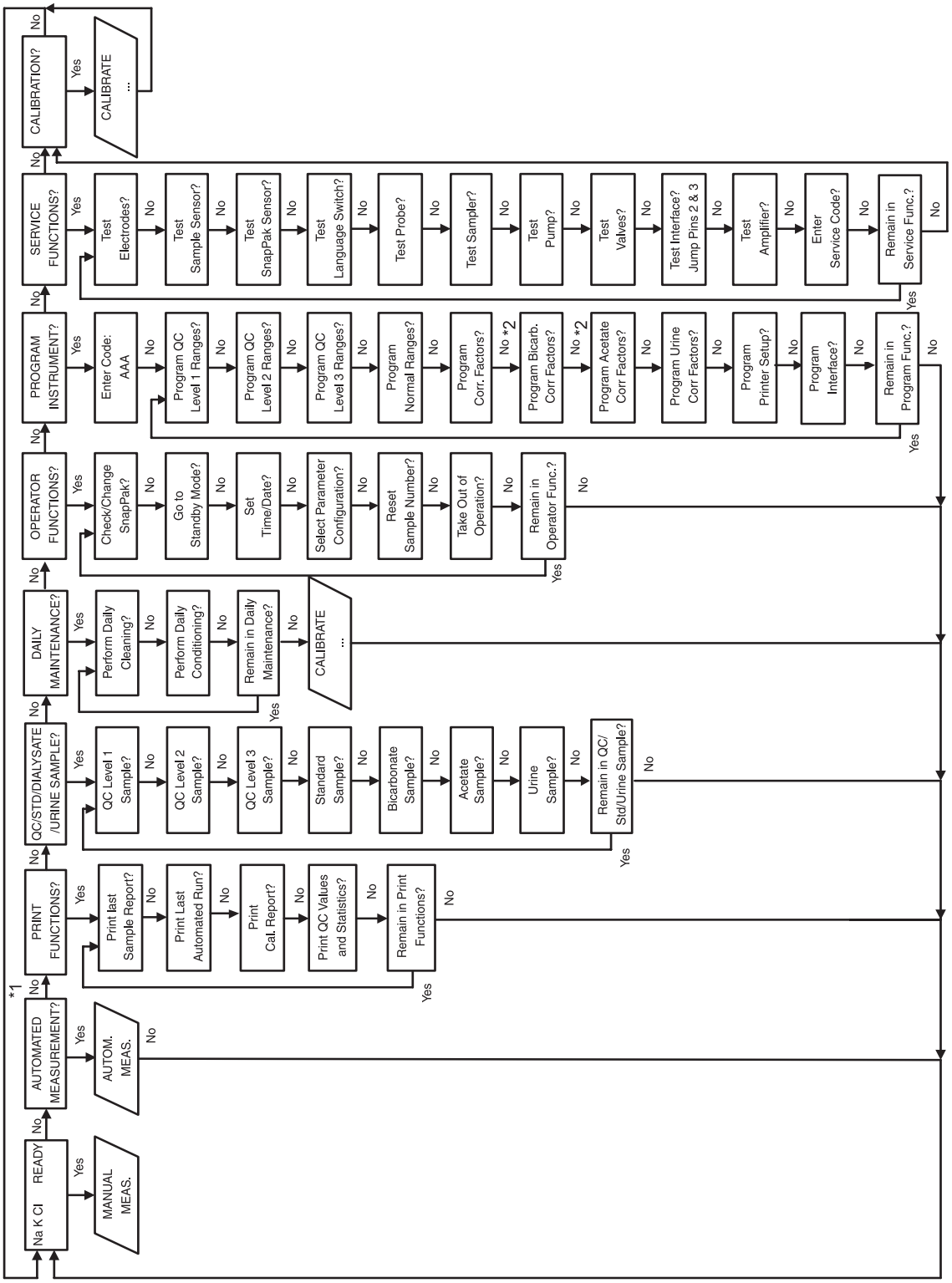
8 Program Instrument Menu

9 ervice Functions Menu

10 Calibration Sequence

11 Power-up Sequence

Overall program operting flow



*1 only with Autosampler plugged in
*2 with Li off

Figure B-33 9181 program flow

Main menu

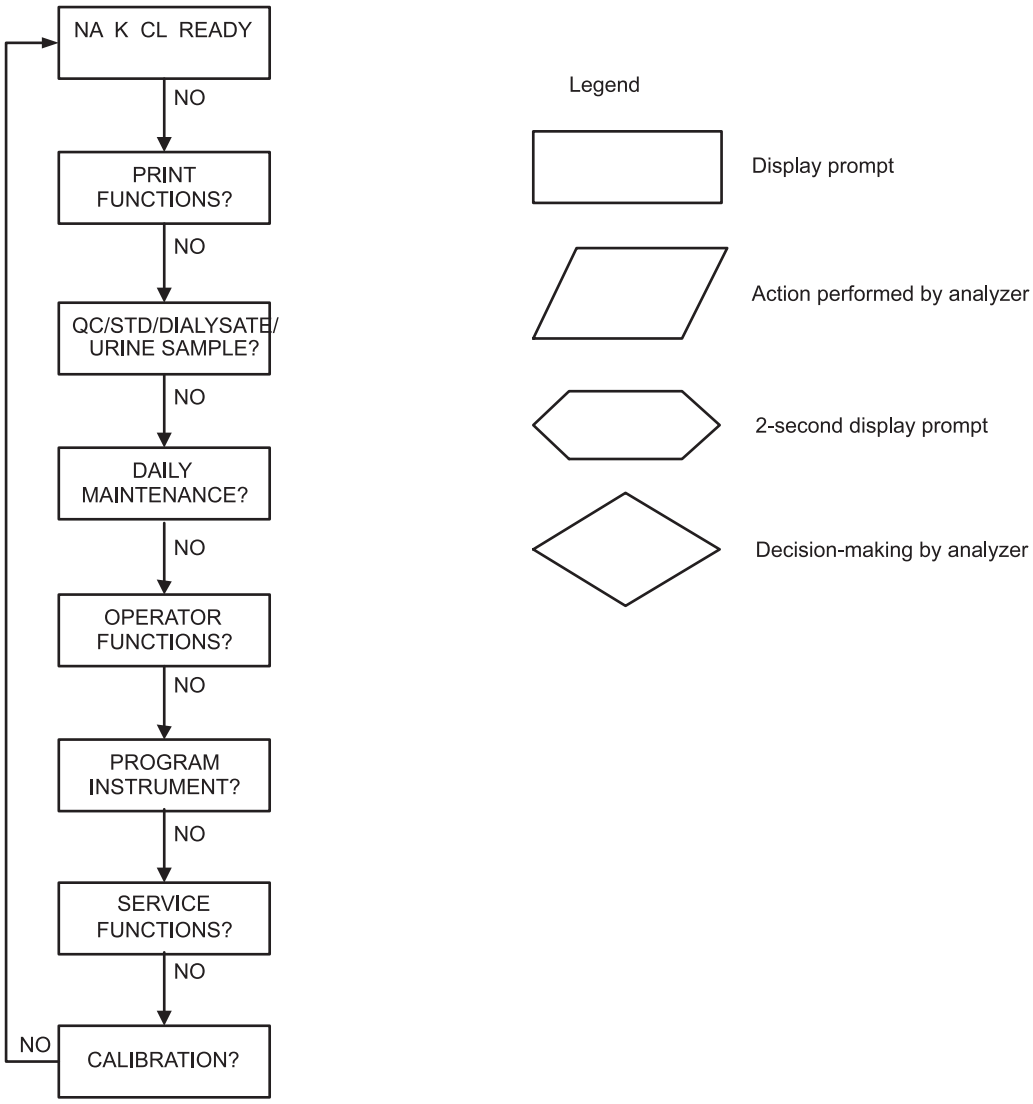


Figure B-34 9181 main menu

Manual measurement sequence

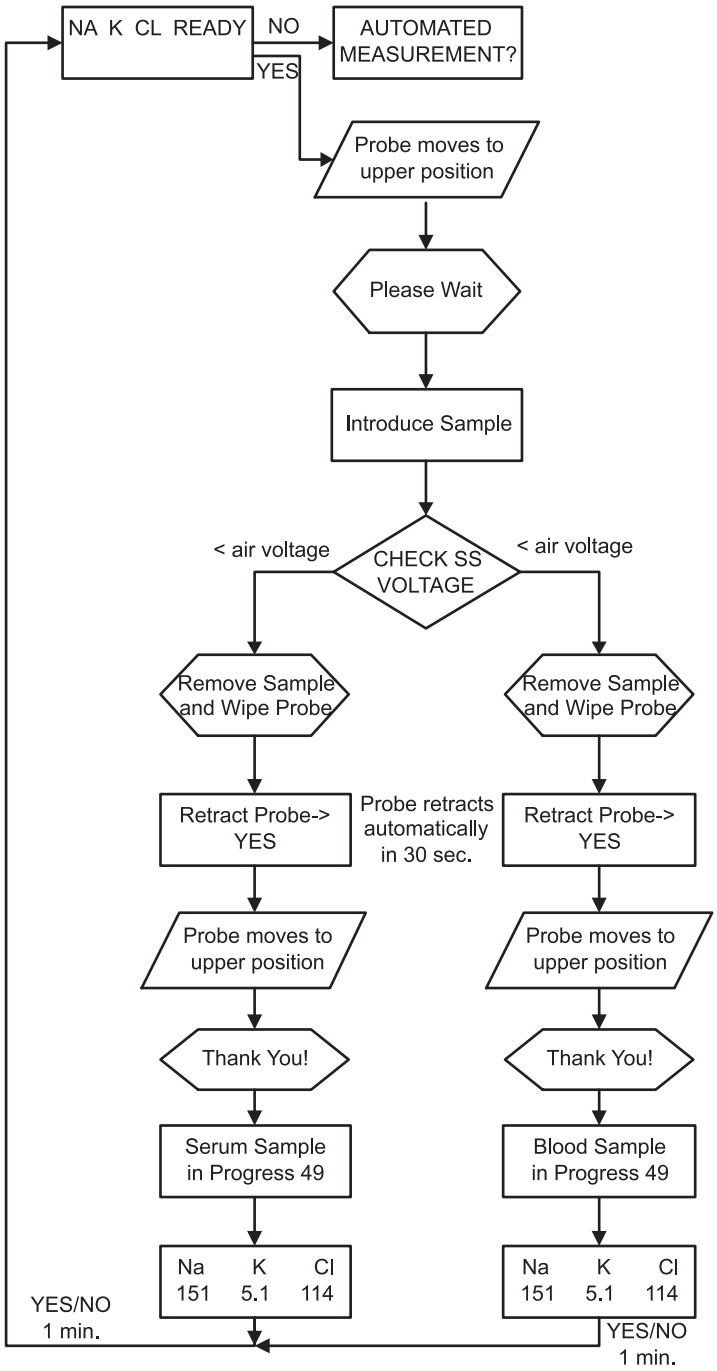


Figure B-35 9181 manual measurement sequence

Automated measurement sequence

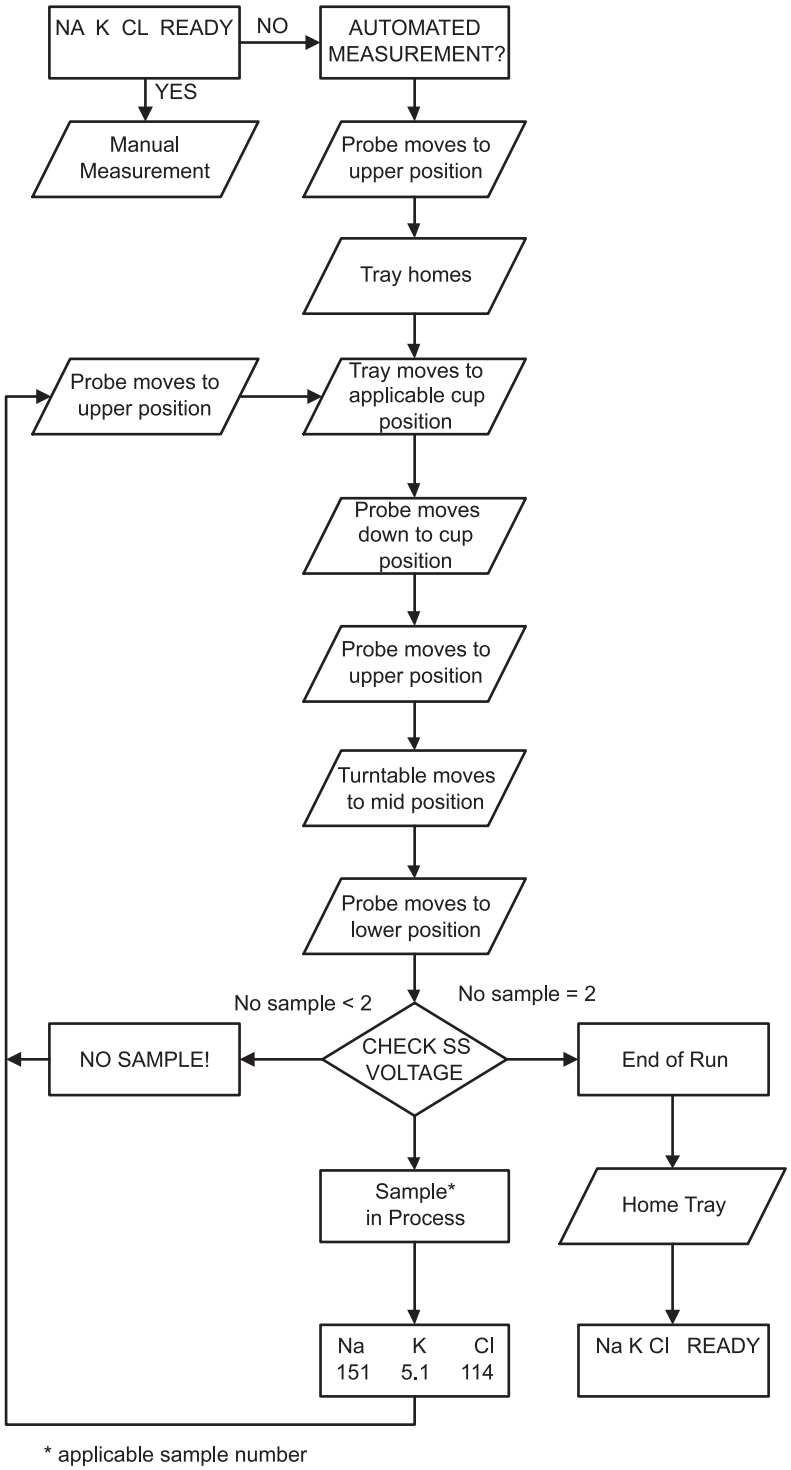


Figure B-36 9181 automated measurement sequence

Print functions menu

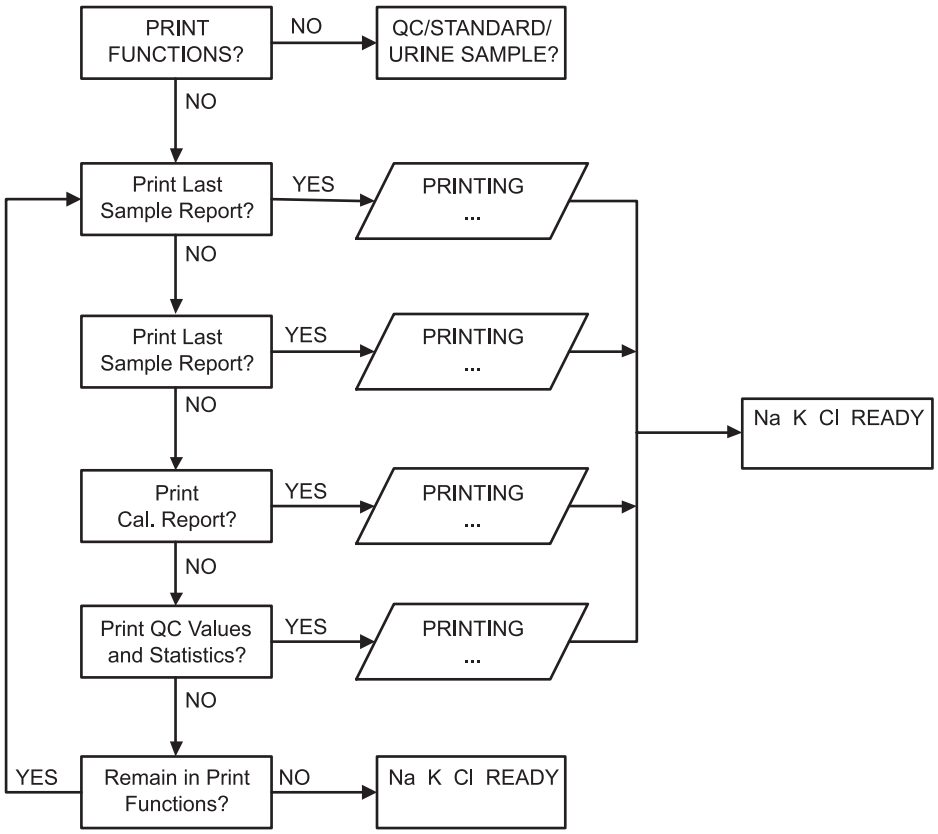


Figure B-37 9181 print functions menu

QC/std/dialysate/urine sample menu

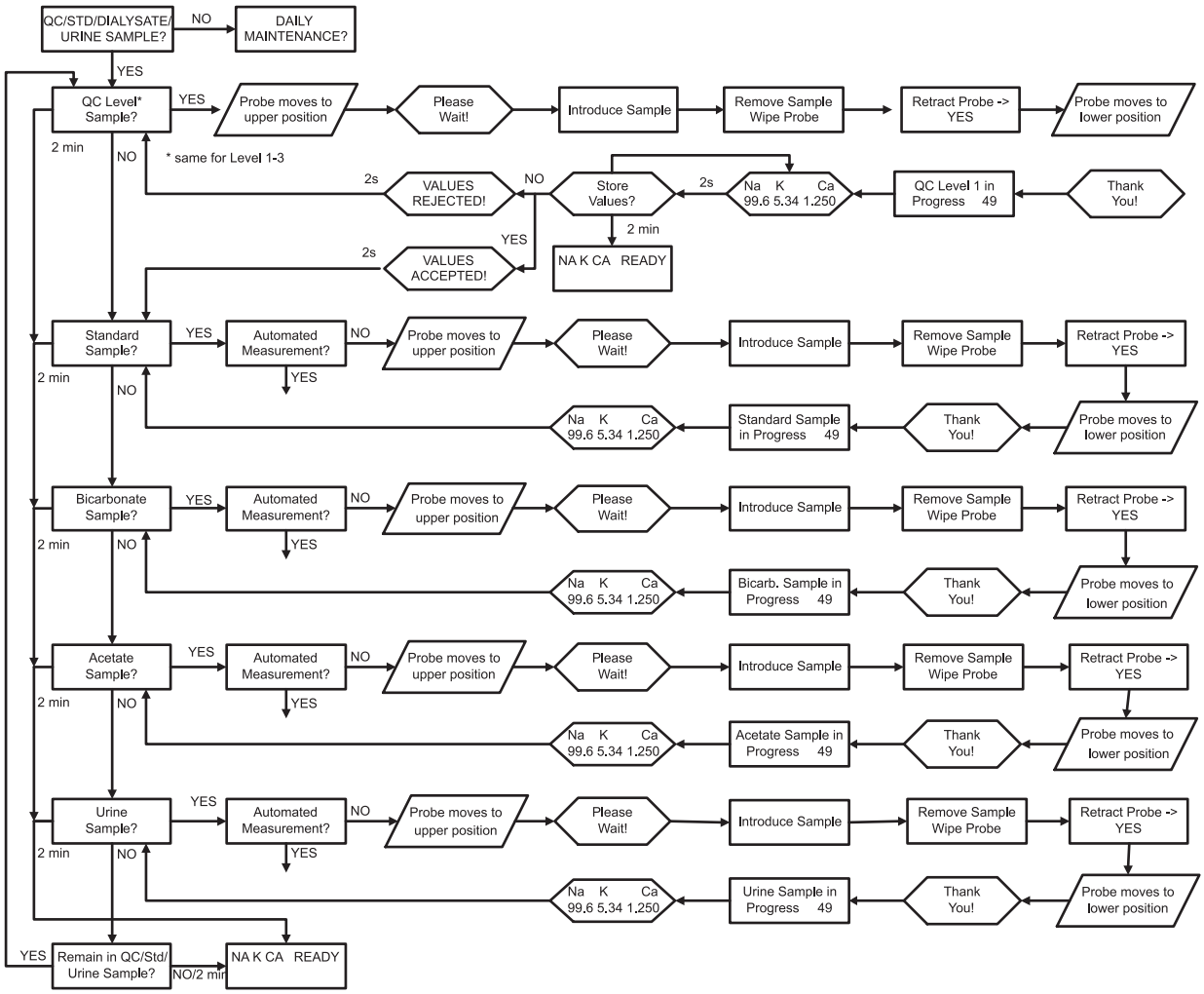


Figure B-38 9181 QC/std/dialysate/urine sample menu

Daily maintenance menu

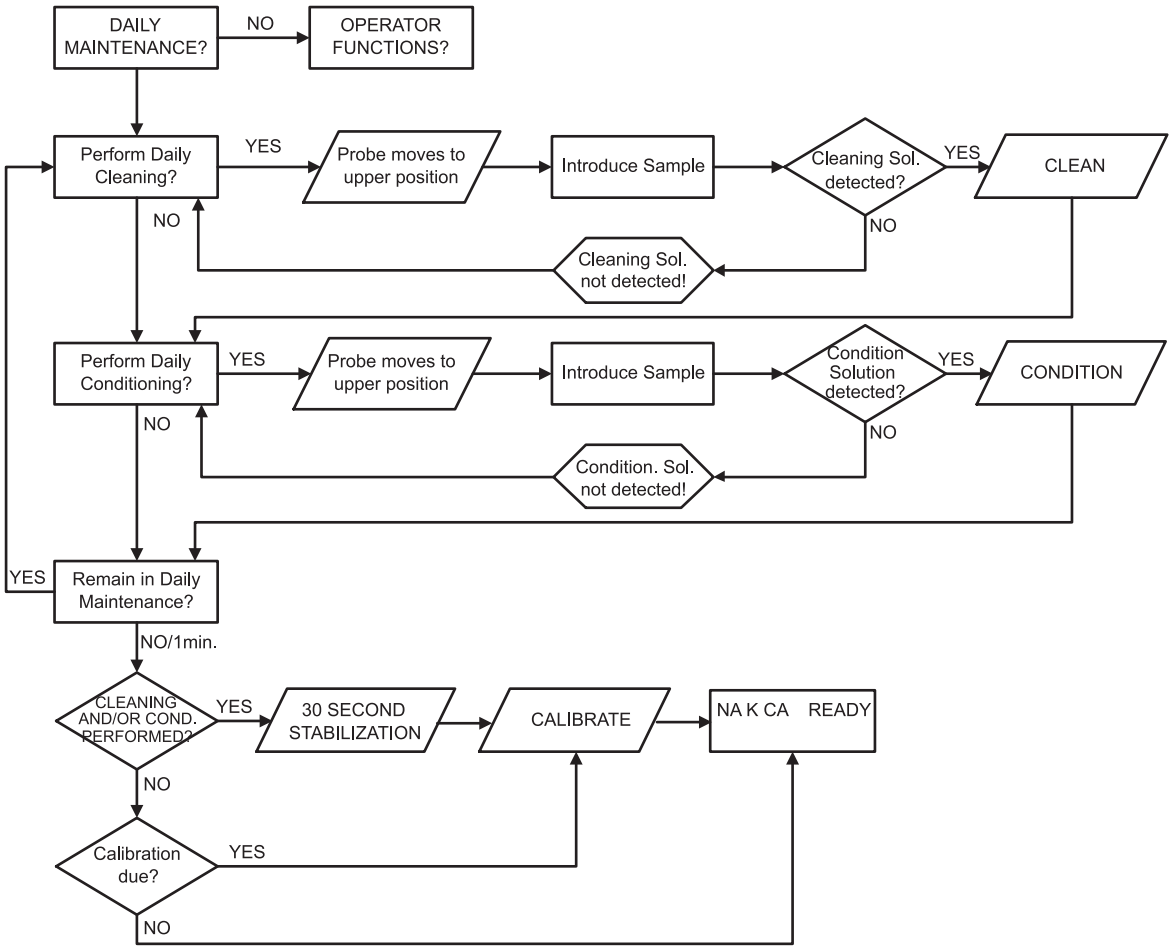


Figure B-39 9181 daily maintenance menu

Operator functions menu

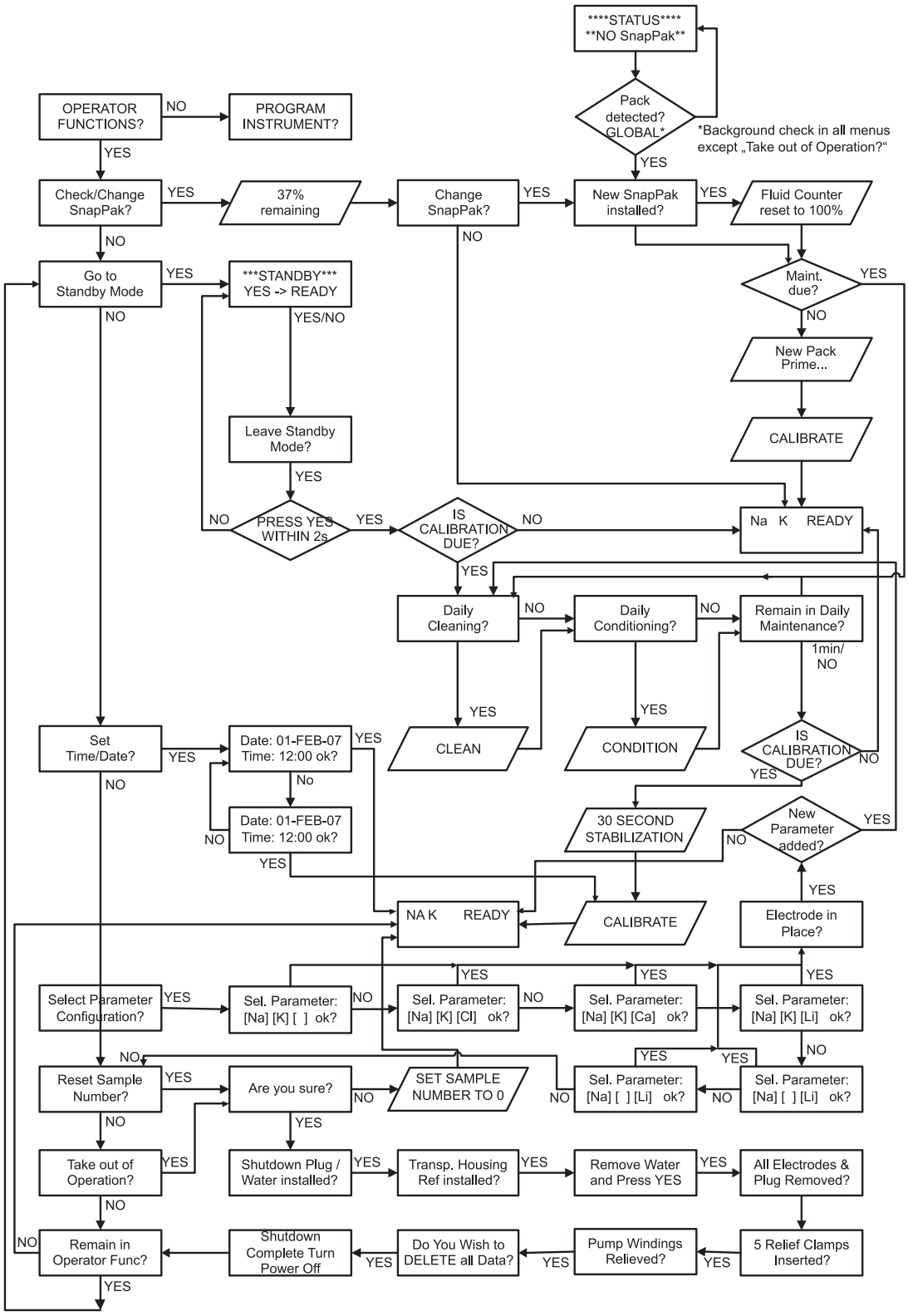


Figure B-40 9181 operator functions menu

Program instrument menu

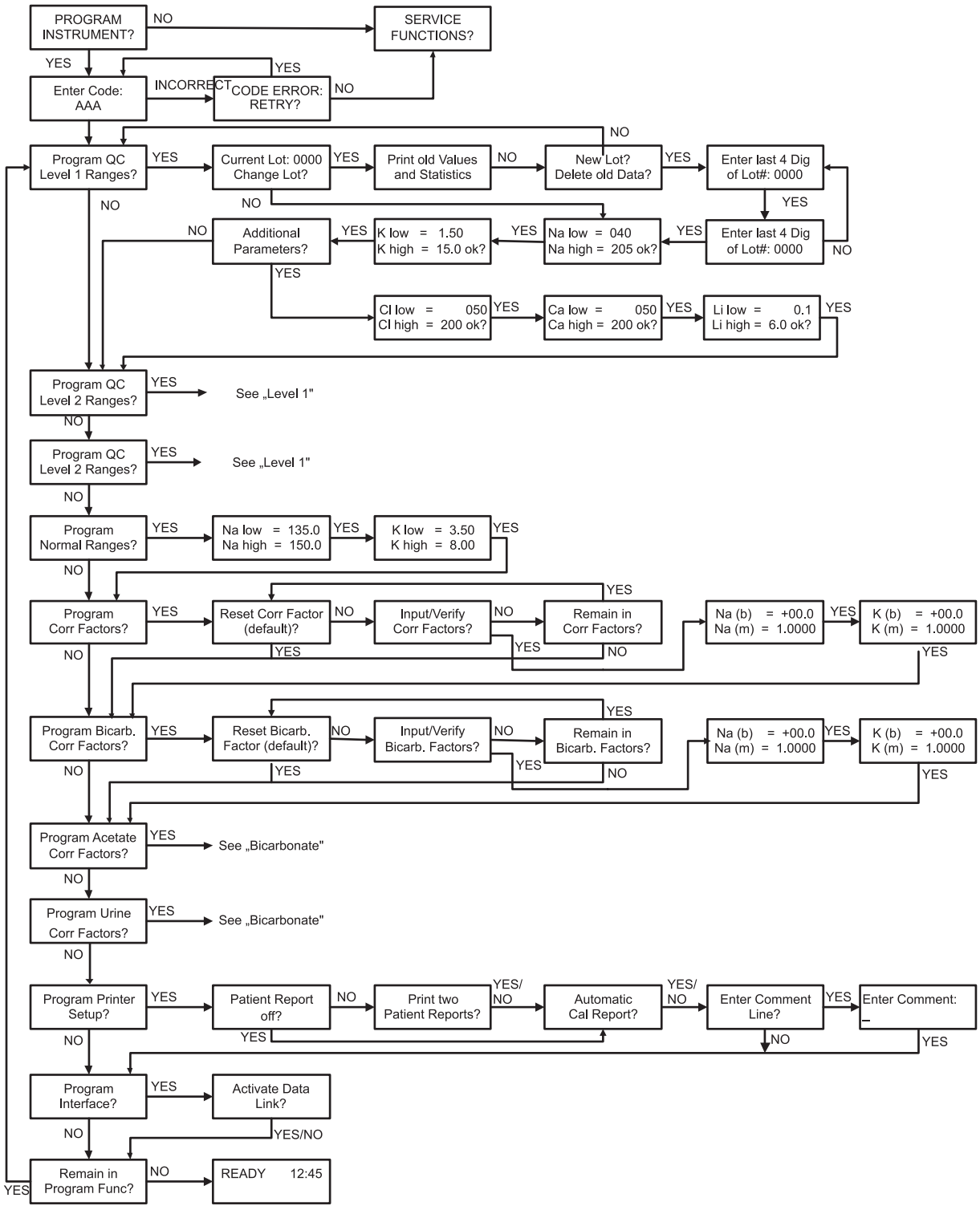


Figure B-41 9181 program instrument menu

Service functions menu

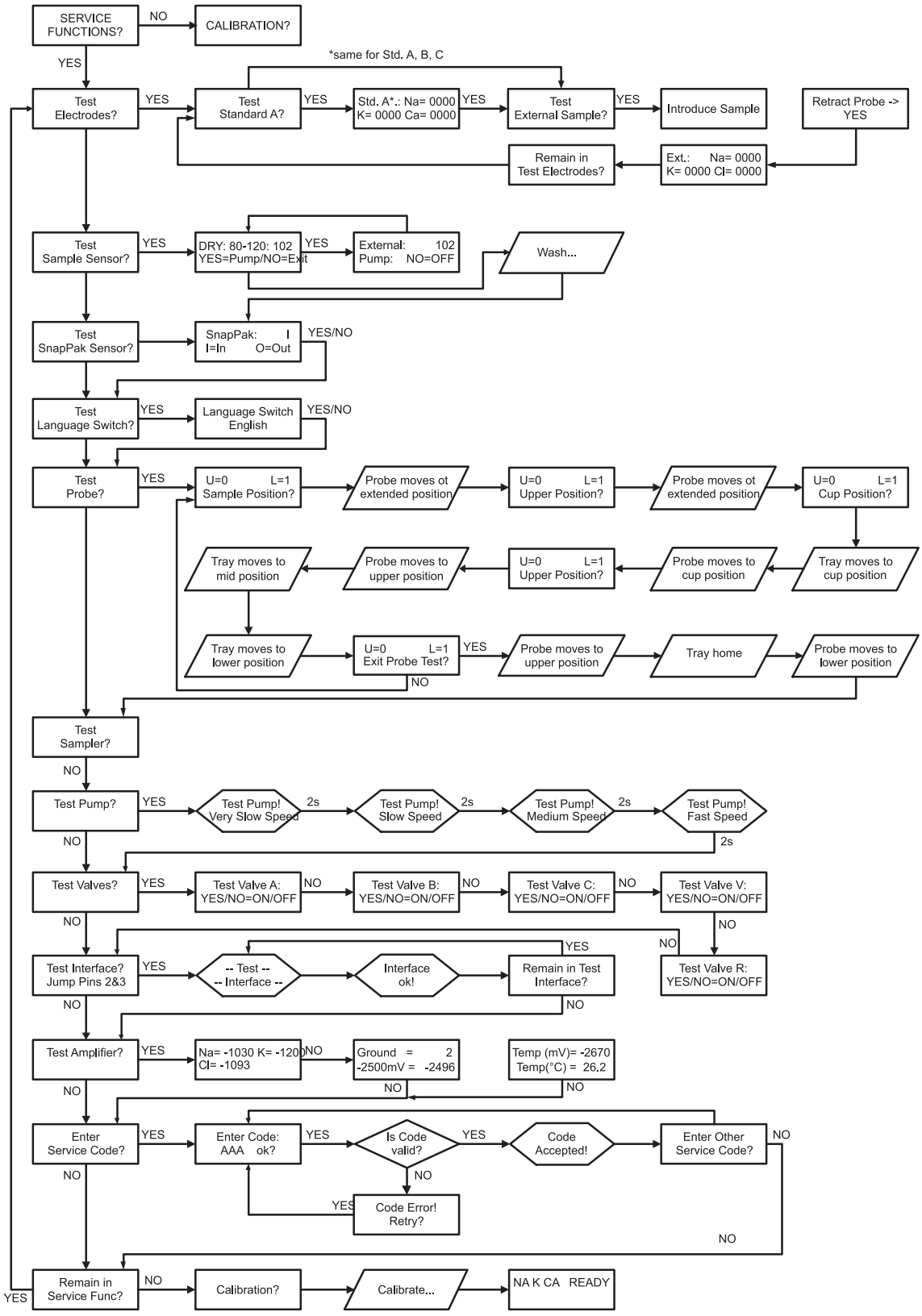


Figure B-42 9181 service functions menu

Calibration sequence (1) (example Na/K/Li calibration)

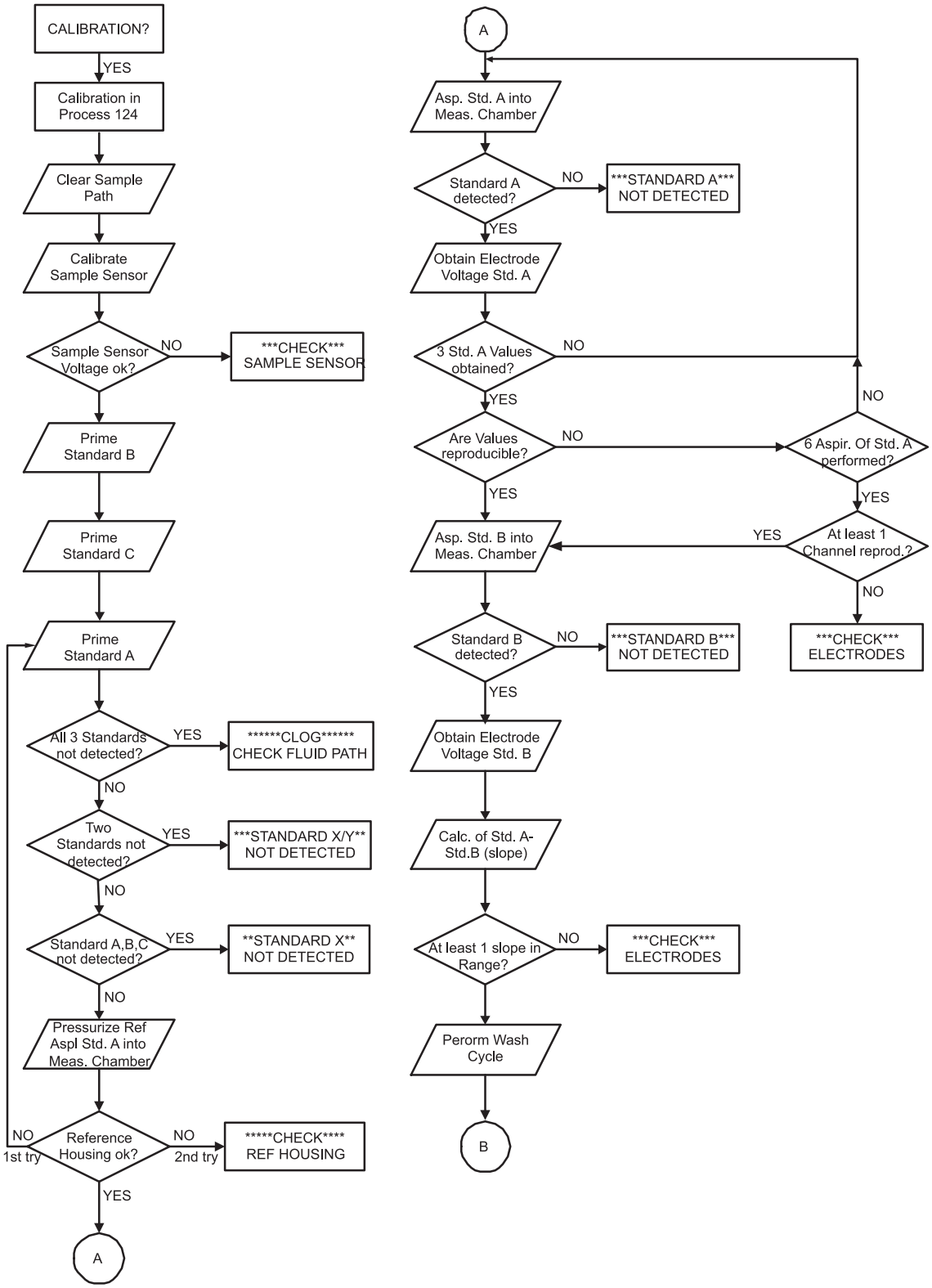


Figure B-43 9181 calibration sequence (1) (example Na/K/Li calibration)

Calibration sequence (2) (example Na/K/Li calibration)

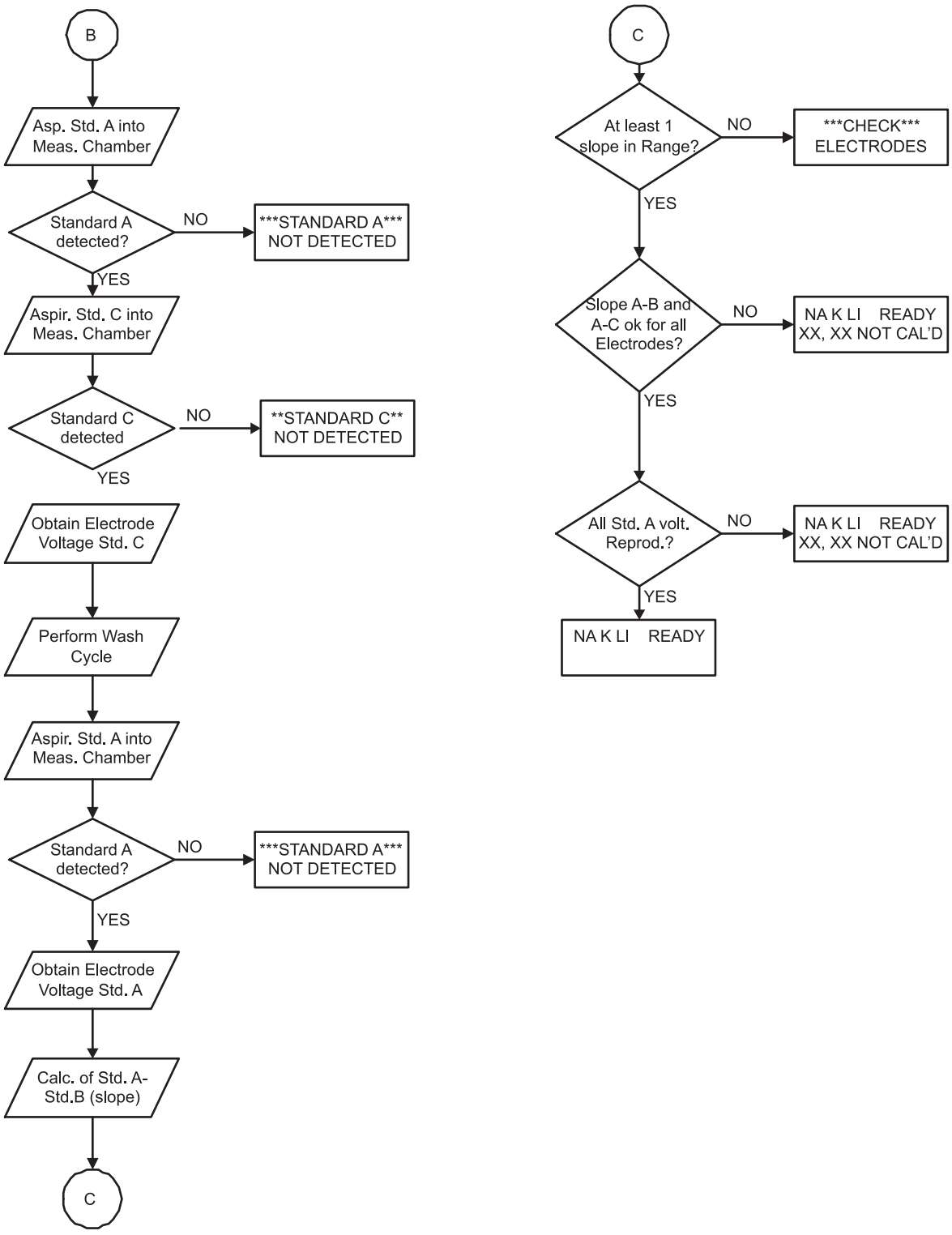


Figure B-44 9181 calibration sequence (2) (example Na/K/Li calibration)

Power-up sequence

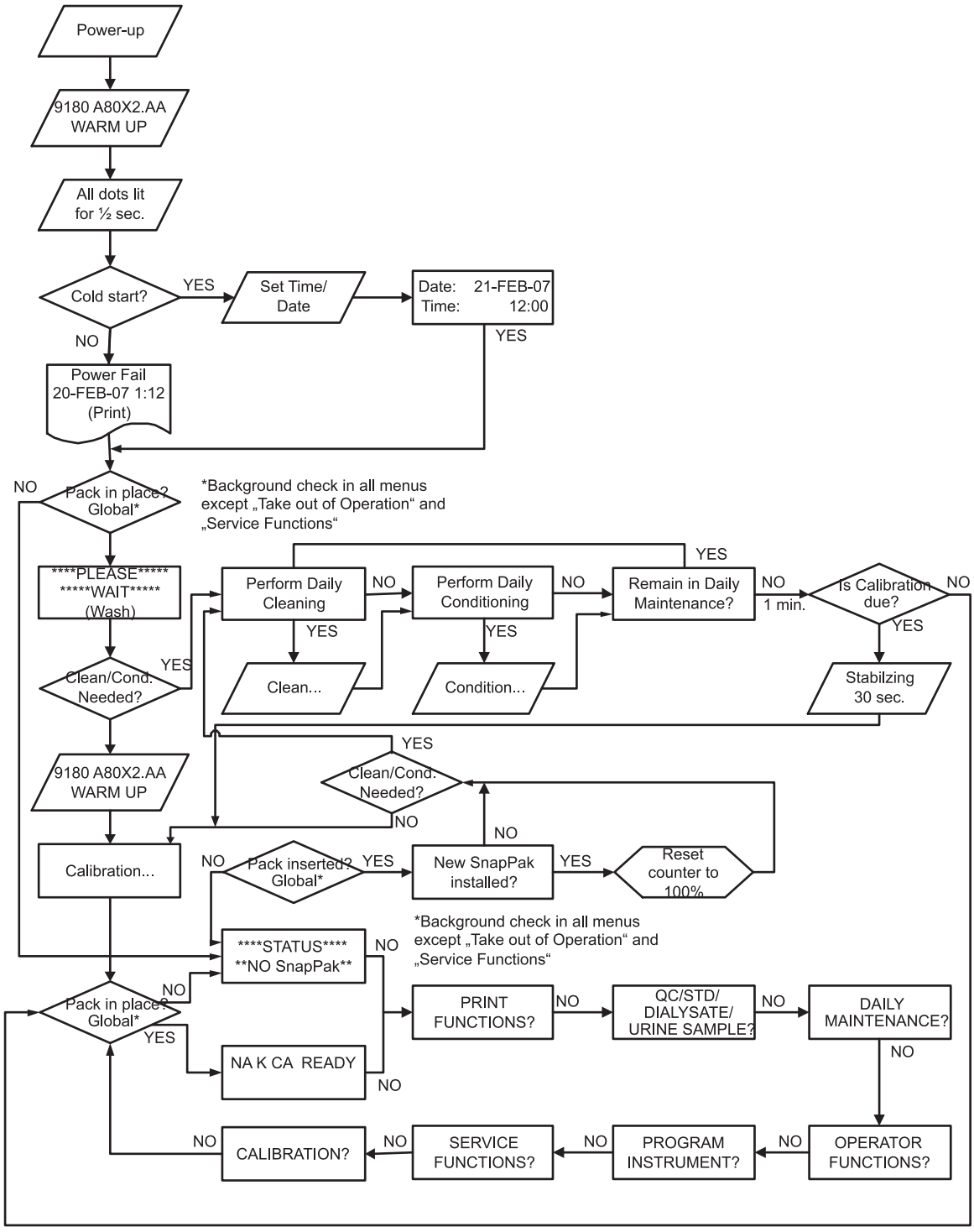


Figure B-45 9181 power-up

Service functions

Insert introducing text here.

In this chapter *Chapter* 10

Service functions B-65
TEST ELECTRODES B-65
TEST SAMPLE SENSOR B-65
TEST SnapPak SENSOR (9180 and 9181 only) B-65
TEST LANGUAGE SWITCH (9180 and 9181 only) B-65
TEST SAMPLE DOOR (except 9181) B-66
TEST PROBE (9181 only) B-66
TEST AUTOSAMPLER (9181 only) B-66
TEST PUMP B-66
TEST PINCH VALVES B-67
TEST INTERFACE B-67
TEST AMPLIFIER B-67
ENTER SERVICE CODE B-68
Miscellaneous functions B-70
Deleting data B-70
Warm-up bypass B-70

Table of contents

Service functions

The Service Functions mode provides a menu of service test functions to assist in failure diagnosis and identification. A logic flow chart is provided for reference of the sequences included in the Service Functions mode.

TEST ELECTRODES

This mode allows for the measurement and display of electrode voltages.

Standard A, Standard B or an external sample can be measured to determine electrode performance and provide measurement data useful in locating electrode calibration faults. Each electrode parameter will be displayed and the electrode voltage associated with the sample type selected can be observed.

Example displays

```
St.A: Na=1582
K=654 Cl=-904
```

```
St.B:
pH=-808
```
(9110 pH Analyzer)

```
Ext: Na=1321
K=-598 Cl=-127
```

TEST SAMPLE SENSOR

In this mode, the sample sensor output is displayed which is useful for electrical adjustment or for troubleshooting sample sensor faults. A dry sample sensor should display a value of 100 with a range of 80 to 120. After verifying a dry sensor, aspiration of a clear fluid (i.e., water) should increase the displayed value by at least 40 units.

Example displays

```
DRY 80-120: 102
YES=Pump/NO=Exit
```

```
External: 153
Pump: NO=OFF
```

```
DRY 135-145: 141
YES=Pump/NO=Exit
```
(9110 pH Analyzer)

TEST SnapPak SENSOR (9180 and 9181 only)

In this test, the SnapPak Sensor detects whether the ISE SnapPak™ is in place. "I" indicates that the ISE SnapPak™ is in place, "O" indicates that it is either not present or not completely seated.

Example display

```
SnapPak: I
I=IN O=OUT
```

TEST LANGUAGE SWITCH (9180 and 9181 only)

This mode displays the language selected for display and printout. To change the selection, set the language switch (located behind printer) to the desired language. The display will indicate the language choice according to the switch setting. To activate a new language, turn the analyzer off and back on with the switch set to the desired language.

Example display

```
LanguageSwitch
    English
```

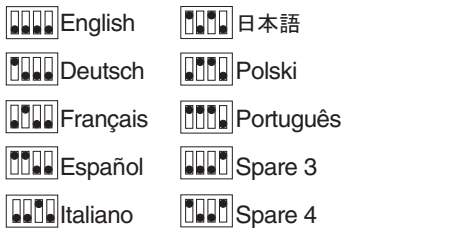


Figure B-46 Example 9180 language label

TEST SAMPLE DOOR (except 9181)

This test verifies the operation of the sample door light gate and its associated circuitry. The display indicates an “O” or “C” depending on the position of the door.

Example display

```
 SampleDoor:C
C:Closed/O:Open
```

TEST PROBE (9181 only)

This test verifies the operation of the sample probe motor, position sensor and associated circuitry. The "U" represents the output of the upper position sensor, the "L" represents the output of the lower position sensor.

Example display

```
U=0 L=1
Sample Position?
```

TEST AUTOSAMPLER (9181 only)

This test verifies the operation of the Autosampler turntable assembly. The display indicates the output of both the position and home sensors.

Note

If the Autosampler is not plugged in or the TABLE PRESENT bit is not activated, this test will not appear under the [SERVICE FUNCTIONS] menu.

Example display

```
Home=0
Pos=1
```

TEST PUMP

This test turns on the peristaltic pump at each of the four pump speeds. The display indicates for two seconds each pump speed while each pump speed is being tested. Observe that the peristaltic pump changes speed as is indicated on the display.

Example displays

```
---Test Pump!---
Very Slow Speed
```

```
---Test Pump!---
   Slow Speed
```

```
---Test Pump!---
 Medium Speed
```

```
---Test Pump!---
   Fast Speed
```

TEST PINCH VALVES

This test turns on/off each solenoid valve as indicated and is useful to verify both electronic control and mechanical operation of each solenoid valve.

Example displays

```
Test Valve A:
YES/NO = ON/OFF
```

```
Test Valve B:
YES/NO = ON/OFF
```

```
Test Valve C:
YES/NO = ON/OFF
```
(9180/9181 only)

```
Test Valve V:
YES/NO = ON/OFF
```

```
Test Valve R:
YES/NO = ON/OFF
```

TEST INTERFACE

The Interface Test can be used to verify correct operation of the RS232C serial port. To operate this test, jumper pin 2 and pin 3 of the rear interface connector prior to invoking the test. During the interface test, the analyzer sends out a test string and checks if it is received within a set period of time. If correct operation is observed after completion of the test, [INTERFACE OK] will be displayed.

TEST AMPLIFIER

The Amplifier Test displays ground, reference and output voltage of each input amplifier. The values displayed for each electrode channel will be dependent on the electrode inputs and may vary. Display of the ground should read between -10 mV and +10 mV with the reference voltage reading between -2490 mV and -2510 mV. With all inputs open, the display should read +/- 4095 for each channel. On the 9140/9180/9181, an additional display indicating the temperature voltage and temperature in degrees C is available to verify the temperature adjustment. On the 9110, the temperature reading should be between 36.8 and 37.2°C.

Example display

```
Na=#### K=####
 Cl/Ca/Li=####
```
(depending on parameter configuration)

```
GND =0
-2500mV=-2499
```

```
Temp(mV) =-####
Temp(°C) = ##.#
```
(9180/9181 only)

```
    pH=####
```
(9110 only)

ENTER SERVICE CODE

Service Codes are available and allow additional programming features. Following is a listing of the available Service Codes and functions:

Set	Reset	Service code description
ALL	**LLA**	This service code will enable the Ca^{2+} value during auto-(9181 only) matic serum/blood measurement. Special precautions are necessary to obtain the correct Ca^{2+} value due to sample exposure to room air.
CDC	**–**	Clears all Service Codes. *9110: Except SLC.*
DEC	**CED**	Provides one additional digit of resolution for each measured parameter for blood and serum samples. QC and Standard samples are always displayed with high resolution. Urine samples are always displayed in low resolution.
ECO	**OCE**	Allows the operator to run the instrument in the economy mode. The instrument will enter the **STANDBY MODE**. This occurs at the time of the next 2-point calibration when no samples have been analyzed since the last 2-point calibration.
FIF	**IFI**	Allows printing of electrode voltages during printout of measurements and calibrations. (not available for 9140)
LEM	**MEL**	*9180/9181 only!* This service code will print the last 20 error messages.
MGL	**LGM**	This service code is available only in the model 9140/9180/9181 analyzer and enables Ca^{2+} values to be displayed in mg/dL. The normal mode displays values in mmol/L. QC and Standard results are always displayed in mmol/L.
NOB	**BON**	*9180/9181 only!* This service code disables the beep.
QCC	**CCQ**	When this code is enabled, QC values will be reported in direct ISE measurement instead of flame-equivalent values. In this mode, correlation factors are NOT applied to the measured values.
SFC	**–**	*9180/9181 only!* This code allows the input of a percentage for the ISE SnapPak™ counter.
SLC	**CLS**	*9110/9180/9181 only!* When this code is set, the current setting of the leasing counter, which cannot be reset by the operator, is printed on the calibration report.
SSC	**CSS**	*9181 only!* This code toggles needle height to accommodate smaller (9181 only) sample cups. In the default setting, the analyzer works with 2.0 mL cups. To select 0.25 mL sample cups, **SSC** has to be activated. To return to the default setting, **CSS** has to be activated.
CHP	**PHC**	This code allows for the display and printout of pH results in concentration of H^+ ions. The cH^+ will be shown in addition to the pH value. cH^+ is not shown on QC values and statistics reports.

Table B-1 Service code descriptions

Set	Reset	Service code description
EXW	**WXE**	*9110 only!* This code extends the wash cycle following a serum or blood measurement. Normally 10 Standard A segments are used for the wash cycle; with **EXW** set, 20 Standard A segments will be used.
NTD	**DTN**	*9110 only!* When the code **TMP** is set, **NTD** prevents the temperature from (9110 only) being reset after each sample and causes the last temperature value to remain until changed.
TMP	**PMT**	*9110 only!* When this code is set, the [**CHANGE PATIENT TEMPERATURE?**] menu will appear in the sampling process. The analyzer will perform a temperature correction calculation to convert the measured results for the desired patient temperature. The temperature will be reset after each sample to 37°C unless **NTD** is entered. Temperature corrections can only be performed in the range of 15 - 45°C.

Table B-1 Service code descriptions

Code	Description	9110	9120	9130	9140	9180	9181
ALL	Enables Ca^{2+} during automat. blood/ serum measuement				X		
CHP	Display results in concentratio of cH^{+} ions	X					
CDC	Clears all Service Codes	X	X	X	X	X	X
DEC	Additional display resolution	X	X	X	X	X	X
ECO	Economy mode	X	X	X	X	X	X
EXW	Extended wash following serum/blood samples	X					
FIF	Cal. voltages on display	X	X	X		X	X
LEM	Last 20 error messges printed	X		X	X		
MGL	Display mg/dL				X	X	X
NOB	No beep	X				X	X
NTD	Prevents temperature from being reset following each sample	X					
QCC	QC values direct ISE measurement	X	X	X	X	X	X
SFC	SnapPak counter input				X	X	
SLC	Set "Leasing counter"					X	X
SSC	Small sample cups						X
TMP	Allows temperature correction for measured results	X					

Table B-2 Instrument / service code matrix

Miscellaneous functions

Deleting data

Clearing sample count

► To reset the sample count to 0

1 At the [READY] display and press NO until the display [OPERATOR FUNCTIONS?] appears. Confirm with YES.

2 Press NO until [Reset Sample Number?] appears. Press YES.

3 When the prompt [Are you sure?] appears, press YES again.

Clearing all data

► To reset the analyzer software to the default values

1 Press the YES and NO keys simultaneously and switch the analyzer off and on again. This function can be performed optionally upon completion of decommissioning.

CAUTION!

All QC data and instrument programming will be lost.

All QC values and statistics will be deleted and the sample number reset to 0. QC and normal values as well as correlation factors, printer settings, date/time and liquid content of the SnapPak will be reset to default values. All service codes will be deactivated. It is recommended that all data be deleted if the analyzer is to be used by other persons at a later date.

Warm-up bypass

► To bypass the instrument warm-up

1 Press YES and NO keys simultaneously during instrument warm-up.

Maintenance C

11 Adjustments C-3
12 Maintenance C-7

Adjustments

Insert introducing text here.

In this chapter *Chapter* 11

Adjustments C-5
Sample contacts adjustment (9110 only) C-5
Sample sensor adjustment (9120/9130/9140/9180/9181 only) C-5
Temperature Adjustment (9110/9140/9180/9181 only) C-6

Table of contents

Adjustments

The 9110, 20, 30, 40, 80 and 81 Analyzers have been designed to require minimal electronic adjustment. The sample contact circuit may require adjustment following a change of the sample contact components or during a routine troubleshooting (9110 only) or the sample sensor circuit may require adjustment following a change of the sample sensor or during routine troubleshooting. The temperature adjustment is active only for models 9110/9140/9180/9181 and requires the temperature adjustment test plug for correct calibration of the temperature circuit.

Sample contacts adjustment (9110 only)

In preparation for correct electronic adjustment, several steps must be performed.

► To adjust the sample contacts

1. Slide the electrode holder forward and remove the electrode from the analyzer.
2. Disconnect the intake tube from the preheater.
3. Remove the trim panel (located below the needle mechanism) and disconnect the plug for sample contact 1.
4. Select [TEST SAMPLE CONTACTS] in the [SERVICE FUNCTIONS] menu and adjust R10 (Display Board) for a reading of 140.
5. Reconnect sample contact 1 plug, intake tubing and electrode.
6. Check to ensure the value (140) remains the same.

Note

If the value drops after reconnecting each of the three sample contacts, follow the troubleshooting guidelines for fault isolation.

For details, see *Error messages and troubleshooting* on page D-5.

Sample sensor adjustment (9120/9130/9140/9180/9181 only)

► To adjust the sample sensor

1. Select [**TEST SAMPLE SENSOR**] in the [**SERVICE FUNCTIONS**] menu which will display the current sample sensor setting.
2. Adjust R93 Sample Sensor Adjust located at the top of the ISE SBC card to a value of 100.
3. Press **YES** to turn on peristaltic pump and ensure displayed value remains constant.

Raise sample door and aspirate clear fluid (e.g. water). Displayed reading should now be 150 or greater.

Note

R93 can be accessed through the rear cover vent slot and is located at the top center on the circuit card.

Temperature Adjustment (9110/9140/9180/9181 only)

► To adjust the temperature amplifier

1. Select [**AMPLIFIER TEST**] in the [**SERVICE FUNCTIONS**] menu which will display the current amplifier voltages.
2. Press **NO** twice to display the temperature voltage and actual temperature display.
3. Unplug the preheater (9110 only) or the sample sensor and fit the Temperature Adjustment Test Plug in place of the preheater or sample sensor plug.
4. Adjust R54 located on the SBC Board for a display of 3000 mV.
5. Unplug the Temperature Adjustment Test Plug and fit the preheater or the sample sensor connector to display the actual temperature.

9110 Wait 5 minutes for the preheater to stabilize. The display should now read 37.0±0.2°C. Adjust R20 on the display board (clockwise to increase) for 37.0±0.1°C.

9140/9180/9181 Due to the elevated temperature inside the analyzer, it is normal for the displayed temperature to be several degrees C higher than the actual room temperature.

If no Temperature Adjustment Test Plug is available, place a quality thermometer (preferably mercury) next to the right side electrode holder. With the front door open, wait approx. 10 min. Then adjust the displayed temperature to match the reading on the thermometer.

Maintenance

Insert introducing text here.

In this chapter *Chapter* 12

Maintenance C-9
Daily maintenance C-9
Weekly maintenance C-9
Monthly maintenance C-9
Six month maintenance C-9
Annual preventive maintenance C-9

Maintenance

Maintenance procedures for the 9110, 20, 30, 40, 80, 81 Analyzers require minimal time by the operator to perform. The procedures outlined below should be performed by the schedule indicated. Detailed instructions for these procedures can be found in the *Instructions for Use* describing the correct method to perform routine analyzer maintenance.

Daily maintenance

- ☐ Perform cleaning cycle.
- ☐ Perform conditioning cycle.

Weekly maintenance

- ☐ Clean sample probe and fill port.
- ☐ Clean analyzer surfaces.

Monthly maintenance

- ☐ Clean reference electrode housing.
- ☐ Check level of pH Filling Solution (9110 only).

Six month maintenance

- ☐ Replace peristaltic pump tubing.

Annual preventive maintenance

- ☐ Replace complete tubing set.
- ☐ Replace peristaltic pump tubing.
- ☐ Replace intake tubing (9110 only).
- ☐ Replace fill port assembly.
- ☐ Replace sample probe.
- ☐ Replace sample sensor Quad-ring (9120/30/40/80/81 only).
- ☐ Replace preheater Quad-ring (9110 only).
- ☐ Check sample sensor voltage (9120/30/40/80/81 only).
- ☐ Check sample contact voltage (9110 only).
- ☐ Check sample temperature (9140/80/81 only).

Troubleshooting D

13 Troubleshooting D-3

Troubleshooting

In this chapter *Chapter* 13

Error messages and troubleshooting D-5
Status-LEDs D-5
STATUS: NOT CALIBRATED D-5
STANDARD A NOT DETECTED D-5
STANDARD B NOT DETECTED, STANDARD C NOT DETECTED (9180/9181 only) D-6
CHECK SAMPLE CONTACTS(9110), CHECK SAMPLE SENSOR (9120/30/40/80/81) D-6
CHECK REFERENCE HOUSING D-7
PLEASE CLOSE SAMPLE DOOR (except 9181) D-7
NO SAMPLE D-8
CLEANING FLUID NOT DETECTED D-8
CONDITIONING FLUID NOT DETECTED (except 9110) D-8
INTERFACE ERROR D-9
PAPER JAM OR PRINTER DEFECT D-9
CHECK ELECTRODES D-9
NOT CAL'D D-9
CLOG IN SAMPLE PATH (9110 only), CLOG CHECK FLUID PATH (except 9110) D-11
↑↑↑↑ ↓↓↓↓ (Out of range) D-11
↑ ↓ (Temparature out of range) D-11
ERR D-12
PERFORM DAILY MAINTENANCE (except 9110) D-12
REPLACE FLUID PACK D-12
CHECK TEMPERATURE (9140/9180/9181 only) D-12
VALVE OVERTEMP! CHECK VALVES D-13
ERROR: UPPER NEEDLE SENSOR D-13
ERROR: LOWER NEEDLE SENSOR D-13

WHEEL MISSING OR SAMPLER DEFECT D-13
SAMPLER JAMMED OR DEFECTIVE D-14

Error messages and troubleshooting

Status-LEDs

The 5 status LEDs at the bottom of the chassis back panel are lit simultaneously during normal operation. See below if any LED is blank.

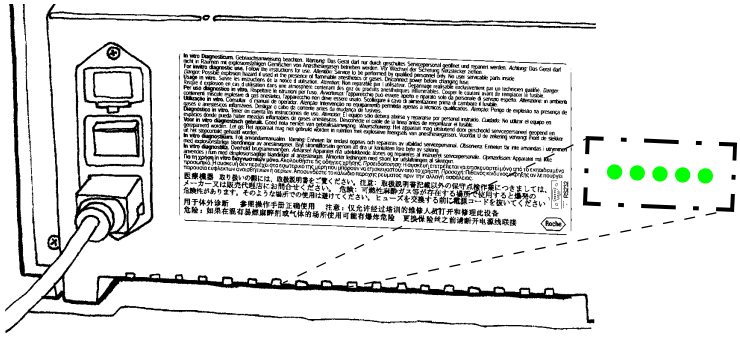


Figure D-1 Status LEDs (back panel, bottom)

Possible causes and remedies

- One ore more supply voltages are out of range or missing. Check the voltage test points.

  For details, see *Power circuits* on page A-33.
- If the voltages are correct:
  - Check subsequent cicuits and cabling for obvious damage and replace, if necessary.
  - Check and replace the corresponding fuse.
- Replace the SBC board.
- Replace the power supply.

STATUS: NOT CALIBRATED

This message is only displayed when a calibration has been interrupted by pressing **NO** or opening the sample door. Perform a calibration to return to the [READY] Mode.

STANDARD A NOT DETECTED

This message is displayed when sample contact 1 (9110 only) or the sample sensor is unable to properly detect the Standard A solution in a programmed time period. As the analyzer draws a sample of Standard A, the leading edge of the solution is detected by sample contact 1 (by bridging solution between both parts of sample contact 1) or the sample sensor. The sample sensor must also detect a continuous flow of Standard A Solution into the sample chamber, lasting several seconds, without encountering air bubbles or air. After several seconds, the trailing edge of the

Standard A sample is sensed, the peristaltic pump stops and measurement occurs. If aspiration fails, the analyzer will wash and repeat up to 3 times.

Possible causes and remedies

- Check for air leaks preventing the Standard from being drawn into the chamber. Ensure that all O-rings are in place.

  There must be a continuous draw of standard solution, free of air bubbles.
- Check solenoid V for proper sealing of the vent line.
- Check fill port to ensure the absence of air leaks.
- Verify that the sample needle is not bent.
- Check/replace fill port and wash port to ensure the absence of air leaks (9110 only).
- Check for clots or crystals formed in the Standard A tubing or electrode chamber.
- Replace peristaltic pump tube set to ensure proper sample aspiration.
- Ensure that the preheater cable (9110 only) or the sample sensor is plugged in securely and perform ☞ [**TEST SAMPLE CONTACTS**] or ☞ [**TEST SAMPLE SENSOR**] to ensure correct operation. Clean, adjust or replace sample sensor to correct sample sensor operation.
- Check the fluid remaining in the ISE SnapPak™. If less than 5% remains, replace the ISE SnapPak™.

STANDARD B NOT DETECTED, STANDARD C NOT DETECTED (9180/9181 only)

The system for drawing Standard B or C is like that of Standard A. If Standard A is drawn properly and Standard B or C is not detected, check Standard B tubing for crystallization. Perform checks for Standard A detection problems to correct. During the calibration sequence, Standard B or C is drawn into the measuring chamber prior to Standard A, therefore check if Standard A calibrant can be properly detected to isolate possible fluidic faults. If neither Standard A, B nor C are detected check for air leaks or blockages within the fluidic path.

CHECK SAMPLE CONTACTS(9110), CHECK SAMPLE SENSOR (9120/30/40/80/81)

The sample contacts must provide a reading of 135 - 145 when air is detected and the sample sensor must provide a reading of 80 - 120 when air is detected.

Perform ☞ [**TEST SAMPLE CONTACTS**] or ☞ [**TEST SAMPLE SENSOR**] to observe sample contact or sample sensor response. When clear fluid (e.g. water) is aspirated, the sample sensor display must indicate an increase of of at least 40 units. For blood samples (not transparent), the reading should decrease by at least 40 units. The sample contacts can be adjusted (see cross reference below), the sample sensor is calibrated with air during each calibration.

👁 For details, see *Sample contacts adjustment (9110 only)* on page C-5.

Perform a calibration to remove the error message after troubleshooting.

Possible causes and remedies

- Check for correct drying of measuring chamber during the wash cycle.
- Replace peristaltic pump tube set.

9110

- Check for clots and leaks in the sample path, especially in the fill port area.
- Clean the sample contacts using Electrode Cleaning procedure.
- Test and adjust sample contacts to correct adjustment.
- Replace sample contacts as needed.

Note

Sample contacts can be tested by invoking [TEST SAMPLE CONTACTS] within [SERVICE FUNCTIONS]. If reading is low, disconnect each sample contact and notice a change in the displayed result to isolate a specific contact fault.

9120/30/40/80/81

- Clean sample sensor using Daily Cleaning procedure.
- Test and adjust sample sensor to correct adjustment.
- Replace sample sensor assembly.

CHECK REFERENCE HOUSING

At the beginning of a calibration, pressure is formed in the reference housing while the R valve is closed and the V valve is open. After Standard A is detected in the sample chamber, the back pressure formed in the reference housing causes the Standard A solution to move back toward the preheater (9110) or the sample sensor. When the standard A solution is detected by the preheater (9110) or the sample sensor, the R valve is opened to release the pressure. If the preheater (9110) or the sample sensor does not detect standard A as it moves back, [**CHECK REFERENCE HOUSING**] will be displayed.

Possible causes and remedies

- Check for clogged reference housing and clean per monthly maintenance procedures.
- Check and ensure that reference tubing is securely connected at the tubing connector.
- Check for proper filling of the reference housing and ensure that reference solution reagent level allows complete filling of the reference housing.
- Check for bubble-free aspiration of Standard A.

PLEASE CLOSE SAMPLE DOOR (except 9181)

This message occurs and prints [**NO SAMPLE**] on the print-out, when either of two conditions exists.

- Sample door is not closed within 20 seconds after samples are in place.
- Sample door has been opened and no sample is detected within 20 seconds.

Possible causes and remedies

- Close sample door within the time allowed.
- Check needle mechanism light gate.
- Check whether preheater (9110) or sample sensor is plugged in.

NO SAMPLE

This message is displayed when any of the following conditions occur:

- During sampling, either a bubble in the sample is detected or the sample size is smaller than the minimum sample required.
- The sample door is opened and no sample is fed into the analyzer.
- Sample door is not closed within 20 seconds after sample is detected.

Possible causes and remedies

- Check whether the sample sensor is plugged in and perform ☞ [TEST SAMPLE CONTACTS] or ☞ [TEST SAMPLE SENSOR] to verify that it operates correctly.
- Check sample draw and look for clots or leaks in the sampling system.

CLEANING FLUID NOT DETECTED

When the cleaning cycle has been initiated, the analyzer checks for proper aspiration of the cleaning solution using the sample contacts (9110) or the sample sensor. If solution is not detected in the proper time, above error message will be displayed.

Possible causes and remedies

- Ensure that a sufficient volume of cleaning solution is presented for aspiration and no air bubbles are present as solution is aspirated.
- Check to ensure that the solution is being aspirated through the sampling mechanism correctly. The sample path must be free of leaks or clots.
- Verify that sample sensor is properly plugged in and perform ☞ [TEST SAMPLE CONTACTS] or ☞ [TEST SAMPLE SENSOR] to verify the correct operation of the sample sensor.
- Check pump tubing and replace as necessary to ensure a correct pump rate.

CONDITIONING FLUID NOT DETECTED (except 9110)

When the conditioning cycle has been initiated, the analyzer checks for proper aspiration of the conditioning solution using the sample sensor. If the solution is not detected in the proper time, this error message will be displayed.

Possible causes and remedies

- Ensure that a sufficient volume of conditioning solution is presented for aspiration and no air bubbles are present as solution is aspirated.

- Check to ensure that the solution is being properly aspirated through the sampling mechanism. The sample path must be free of leaks or clots.
- Verify that sample sensor is correctly plugged in and perform ☞ [**TEST SAMPLE SENSOR**] to verify its proper operation.
- Check pump tubing and replace as necessary to ensure correct pump rate.

INTERFACE ERROR

This message is displayed only during the ☞ [**INTERFACE TEST**]. Pins 2 and 3 must be shorted together to perform the ☞ [**INTERFACE TEST**]. Make sure that the pins are not shorted to chassis ground.

Possible cause and remedy

- Replace SBC Card.

PAPER JAM OR PRINTER DEFECT

This message is displayed when the printer head is jammed and tries to print. It is a temporary message that is displayed for 2 seconds and then sample results are displayed. To clear paper jam remove printer from the analyzer and remove jammed paper. Replace printer and retry. The printer can be removed by grasping the rear edge of the printer assembly and pulling it to the front. The printer can be removed with the Analyzer power on. To free up jammed paper, turn the small gears on the left side of the printer module.

CHECK ELECTRODES

This message is displayed when either of the following conditions are present.

1 More than six aspirations of Standard A are required for all electrode channels.

2 The difference between voltage A and B is out of specification for all channels.

Possible causes and remedies

- Check the level of the filling solution in the pH electrode (9110 only).
- Electrodes are not plugged in. Check the slide mechanism to ensure it is in the correct position and firmly pushed into electrode connectors.
- Perform Electrode Cleaning (9110 only) or Daily Maintenance.
- Check or replace reference electrode.
- Replace ISE SnapPakTM.

NOT CAL'D

- **NA NOT CAL'D** (all except 9110)
- **K NOT CAL'D**
- **CL NOT CAL'D**

- CA NOT CAL'D
- LI NOT CAL'D

These messages will be displayed when a specific electrode does not calibrate properly during a calibration sequence. If more than six standard draws are required or the difference between Standard A and Standard B voltages is out of range, the [**NOT CALIBRATED**] message will be displayed for each channel which exhibits either of these conditions. A copy of the calibration report should be printed to provide the electrode output voltages measured during calibration.

The electrode voltage range table identifies correct voltage ranges for each electrode parameter.

If the difference between Standard A and Standard C (9180/9181 only) is out of range for Li^+ or Na^+, [**LI NOT CAL'D**] will be displayed.

Possible causes and remedies

- Check to ensure calibration reagents are transported correctly. Test for leaks, blockages, bubbles, or improper pump flow rate.
- Check or replace ISE SnapPak™.
- Check whether electrodes are plugged in properly. Check the slide mechanism to ensure it is in the correct position and firmly pushed into electrode connectors. Clean and/or replace electrode.
- If A-C is out of range for Na^+, repeat the calibration or replace the ISE SnapPak™.
- Check or replace SBC Card.

ELECTRODE VOLTAGE RANGES 9110			
Electrode	**Standard A**	**Standard B**	**Allowable Difference A-B**
pH	-2100 to -100	-1600 to +900	-430 to -650

Table D-1 9110 electrode voltage ranges

ELECTRODE VOLTAGE RANGES 9120, 9130, 9140				
Electrode	**Standard A**	**Standard B**	**Allowable Difference A-B**	
			9120/9130	**9140**
Na^+	-600 to +2400	-1600 to +2200	+720 to +2000	+250 to +680
K^+	-700 to +1000	-2500 to +500	+520 to +1800	+470 to +120
Cl^-	-3100 to -100	-1100 to +1800	-520 to -1200	not used
Ca^{2+}	-2600 to +1400	-2100 to +2700	not used	-480 to -900

Table D-2 9120, 9130, 9140 electrode voltage ranges

ELECTRODE VOLTAGE RANGES 9180, 9181					
Electrode	**Standard A**	**Standard B**	**Standard C**	**Allowable Difference**	
				A-B	**A-C**
Na^+	-600 to +2400	-1600 to +2000	-600 to +2400	+250 to +680	-50 to +50
K^+	-700 to +1000	-2500 to +500	-700 to +1000	+470 to +1200	-40 to +40
Cl^-	-3100 to -100	-1000 to +3000	-3100 to -100	-370 to -860	not used
Ca^{2+}	-3100 to +1000	-2300 to +2500	-3100 to +1000	-350 to -660	-150 to +150
Li^+	-3100 to +1900	-3600 to +1400	-2600 to +3400	+1 to +760	-1730 to -285

Table D-3 9180, 9181 electrode voltage ranges

CLOG IN SAMPLE PATH (9110 only), CLOG CHECK FLUID PATH (except 9110)

After completion of sample measurement or calibration, the analyzer will monitor the sample sensor to determine if the sample path has been cleared. This message will be displayed if the sample path has not been cleared.

Possible causes and remedies

- Check for leaks in the fill port and electrode area.
- Check for blockages in the sample path, especially in the sample probe, the tubing to the preheater or the sample sensor and in the preheater or the sample sensor.
- Perform Electrode Cleaning (9110 only).
- Check sample contacts (9110 only) or sample sensor is securely plugged in and check Sample Contact Test (9110 only) or Sample Sensor Test to ensure correct operation.
- Check peristaltic pump and tubing are correct and all tubing is properly in place.

↑↑↑↑ ↓↓↓↓ (Out of range)

In case the analyzer displays arrows up or arrows down instead of sample results, the concentration of the sample is outside of the measurement range.

Possible causes and remedies

- If the sample is a urine sample, arrows up instead of the K^+ result indicate that further dilution of the specimen is required (except 9110).
- Check for proper sample preparation.
- Ensure that the sample is correctly aspirated into the measuring chamber and ensure small air bubbles are not present.
- Check for proper aspiration of Standard A.
- Check the programmed conversion factors. The sample result has to be within the measurement range after conversion factors have been applied.
- Check the level of Filling Solution in the pH Electrode.

↑ ↓ (Temparature out of range)

On the 9140, 9180 and 9181 models, the calibration report will print an arrow up or down instead of the actual temperature, if the temperature measured is out of range (10.0°C - 40.0°C). The temperature sensor is located in the right side electrode holder.

Possible causes and remedies

- Ensure that sample sensor cable is securely plugged in.
- Check whether room temperature is within specified limits (15°C to 32°C / 60°F to 90°F).
- Perform temperature adjustment procedure.
- Replace SBC board or right side electrode holder.

ERR

The analyzer will display **ERR** in place of sample results when the analyzer is unable to obtain valid voltage readings from the electrode (A/D over- or underflow).

Possible causes and remedies:

- Ensure that the electrodes are securely in place and plugged into the analyzer.
- Check to ensure proper filling of the reference electrode has occurred.
- Ensure proper sampling and proper sample preparation. Check for air bubbles in the sample.
- Check level of filling solution in the pH electrode and refill if necessary.

PERFORM DAILY MAINTENANCE (except 9110)

This message will be printed at the end of a sample report when cleaning or conditioning have not been performed within the last 24 hours. This message is printed only. Perform Daily Maintenance to clear this message.

REPLACE FLUID PACK

When the monitored fluid level in the ISE SnapPakTM reaches 5% remaining, the analyzer will print **REPLACE FLUID PACK** at the end of each sample report. This message is printed only. Replace the ISE SnapPakTM following the instructions outlined in the Operator Manual.

To maximize the life of the ISE SnapPakTM, continue running the analyzer until a **STANDARD A NOT DETECTED** message is displayed. This will ensure that the ISE SnapPakTM is completely depleted before replacement.

CHECK TEMPERATURE (9140/9180/9181 only)

On the 9140/80/81 models, the analyzer will display **CHECK TEMPERATURE** at the end of each measurement, if the temperature measured is out of range (10.0°C to 40°C). The temperature sensor is located in the right side electrode holder.

On the 9110, this message will be displayed if the temperature of the preheater is out of range (36.0°C to 38.0°C).

Possible causes and remedies:

- Ensure that the preheater cable (9110 only) or sample sensor cable is securely plugged in.
- Check whether room temperature is within specified limits (15°C to 32°C / 60°F to 90°F).
- Check fuse F3 (LED D3).
- Perform temperature adjustment procedure.
- Replace SBC board or preheater (9110 only) or right side electrode holder.

VALVE OVERTEMP! CHECK VALVES

In case one of the valve solenoids overheats, the message **VALVE OVERTEMP! CHECK VALVES** will be displayed. Each solenoid incorporates a thermo-fuse, which will reset automatically.

Possible causes and remedies

- Turn power off for at least one hour.
- Check fuse F3 (24V).
- Check whether room temperature is within specified limits (15°C to 32°C / 60°F to 90°F).

ERROR: UPPER NEEDLE SENSOR

If probe movement to the upper position is not detected within a certain time period, the above message is displayed.

Possible remedies

- Check for foreign material that may prevent the probe from moving freely.
- Contact Roche Diagnostics for technical assistance.

ERROR: LOWER NEEDLE SENSOR

If probe movement to the lower position is not detected within a certain time period, the above message is displayed.

Possible remedies

- Make sure the fill port is installed correctly.
- Check for foreign material that may prevent the probe from moving freely.
- Contact Roche Diagnostics for technical assistance.

WHEEL MISSING OR SAMPLER DEFECT

During the homing sequence, the sampler checks for the sample wheel to be present.

Possible remedies

- Make sure the wheel is present and seated correctly.
- Replace sample wheel.
- Replace sampler.

SAMPLER JAMMED OR DEFECTIVE

The analyzer checks for correct movement of the sample wheel. If the sample wheel does not move at the expected speed, the above error message is displayed.

Possible remedies

- Check for obstructions preventing the sample wheel from moving freely.
- Replace sampler.

Glossary E

14 Glossary E-3

Glossary

A

Alkaline Basic.

Arterial blood Blood taken from aorta.

Autosampler Sample wheel for automatic measurements with 9181 Electrolyte Analyzers.

C

Clot Catcher Coagulate trap.

D

Dummy electrode The dummy electrode is simply a flow electrode and is only intended as a spacer and it has no additional measuring functions.

E

Electrodes The electrodes are flow-through electrodes with a visible sample channel.

Electrode simulator Test device for the Measuring chamber.

H

Heparin salts Are the only clot inhibitors that may be used for analyses in the 91xx pH/Electrolyte Analyzers.

I

Input unit The sample insertion as well as the aspiration of solutions is carried out via input unit which consists of the sample probe mechanism behind the sample door.

ISE abbr. for ion sensitive electrodes

ISE measuring chamber The ISE measuring chamber and its sensors are used to measure the hematocrit value and the electrolyte values Na^+, K^+, Ca^{2+}, Cl^- and Li^+.

ISETROL QC material for checking ISE.

L

Locking lever This lever fixes the electrodes in the measuring chamber.

M

Measurement evaluation The validity of the test results from the instrument must be carefully examined by a clinical-medical specialist who will take the patient's clinical condition into consideration before any clinical decisions are reached based on the test results.

Measuring chamber Underneath the front door is the ISE measuring chamber with the electrodes.

MC abbr. for "measuring chamber"

N

NIST standards Are precise serums with accredited target values.

P

Peristaltic pump see *Pump*

Plasma Plasma samples are obtained by centrifuging heparinized whole blood, during which the cel-lular components of the blood are removed from plasma.

PP abbr. for peristaltic pump

Printer Low-noise thermoprinter.

Pump One peristaltic pump transports the sample and the operating fluids inside the instrument.

Q

QC abbr. for *Quality control*

QC material see *ISETROL*

Quality control A quality control program includes the analysis of sample materials with known ranges of expected values and the comparison of these values with analyzer results.

R

"Ready" mode Top level of the analyzer mode.

Reference electrode The reference electrode must always produce the same signal, regardless of the sample's composition. This is achieved by mixing the sample flow with a liquid of a higher KCl concentration (reference solution).

Rubber sealing sealing of SnapPak.

S

Sample contact Sample contacts support monitoring (conductivity) when filling the measuring chamber with fluid.

Sample sensor Sample sensors support monitoring (optically) when filling the measuring chamber with fluid.

Sample throughput Number of samples per hour.

SnapPak Calibration solutions for ISE including waste container.

V

Volume limitation Is the maximum volume of sample which is aspirated from the container.

W

Waste Container Waste water, part of the *SnapPak*.

Index F

15 Index F-3

Index

A

Adjustment
– Sample contacts (9110 only), C-5
– Sample sensor (9120/9130/9140/9180/9181 only), C-5
– Temperature (9110/9140/9180/9181 only), C-6
Approvals, A-15

B

Block diagram
– 9110 analyzer, A-39
– 9120, 9130, 9140, 9180 analyzer, A-40
– 9181 analyzer, A-41

C

Classifications
– Approvals, A-15
– Product data, A-15
Cleaning solution (9110 only), A-28
Clear
– all data, B-69
– Sample count, B-69
Common operating parameter, A-14
Contact addresses, 4
Copyrights, 4

D

Deproteinizer, A-7
Description of modules
– Electronics
  – Display board, A-35
  – ISE SBC card, A-33
  – Lamp board, A-34
– Fluidic Module, A-27
  – Cleaning solution (9110 only), A-28
  – Main tube set (all models)/ Intake tube set (9110 only), A-28
  – Reference solution, A-28
  – Sample Contacts (9110 only), A-29
  – Standard A, A-27
  – Standard B, A-27
  – Standard C (not on 9110), A-27
  – Waste liquids, A-28
– Mechanical assemblies
  – Display board, A-27
  – Electrode holder
    – Electrode holder assembly, A-24
  – Front door, A-23
  – Lamp board, A-27
  – Needle unit, A-23
  – Peristaltic pump, A-24
  – Printer, A-25
  – Rear panel, A-25
  – SBC board, A-26
  – Solenoid, A-24
Disinfectants
– Deproteinizer, A-7
– Other disinfectants, A-7
Display board, A-27, A-35
Document information, 3

E

Edition notice, 3
Electronic diagrams, A-39
– 9110 analyzer
  – Display daughter PCB, A-53
  – Preheater PCB, A-54
– 9110, 9120, 9130, 9140 analyzer
  – Lamp PCB, A-52
  – Printer daughter PCB, A-51
  – SBC PCB
    – Analog selector and A/D converter, A-48
    – Input amplifiers, A-46
    – Microprocessor, A-49
    – Power supply, A-43
    – Printer display drivers, A-50
    – Pump motor driver / door detect, A-45
    – Temperature circuit, A-47
    – Valve drivers, A-44
– 9120, 9130, 9140 analyzer
  – Display daughter PCB, A-55
– 9180 analyzer
  – Display daughter PCB, A-67
– 9180, 9181 analyzer
  – Lamp PCB, A-66
  – Printer daughter PCB, A-51
  – SBC PCB
    – Analog selector and A/D converter, A-62
    – Fluid Pack detector, A-65
    – Input amplifier, A-60
    – Microprocessor, A-63, A-64
    – Power supply, A-57
    – Pump motor driver/door detect, A-59
    – Temperature circuit, A-61

– Valve drivers, A-58
– System interconnect, A-56
– Block diagram
– 9110 analyzer, A-39
– 9120, 9130, 9140, 9180 analyzer, A-40
– 9181 analyzer, A-41
– System interconnect - 9110, 9120, 9130, 9140, A-42
Electronics, A-33
– Display board, A-35
– ISE SBC card, A-33
– Lamp board, A-34
Error messages, D-5
– ↑ ↓, D-11
– ↑↑↑↑ ↓↓↓↓, D-11
– CHECK ELECTRODES, D-9
– CHECK REFERENCE HOUSING, D-7
– CHECK SAMPLE CONTACTS(9110), D-6
– CHECK TEMPERATURE (9140/9180/9181 only), D-12
– CLEANING FLUID NOT DETECTED, D-8
– CLOG IN SAMPLE PATH (9110 only), D-11
– CONDITIONING FLUID NOT DETECTED (except 9110), D-8
– ERR, D-12
– ERROR
– LOWER NEEDLE SENSOR, D-13
– UPPER NEEDLE SENSOR, D-13
– INTERFACE ERROR, D-9
– NO SAMPLE, D-8
– NOT CAL'D, D-9
– PAPER JAM OR PRINTER DEFECT, D-9
– PERFORM DAILY MAINTENANCE (except 9110), D-12
– PLEASE CLOSE SAMPLE DOOR (except 9181), D-7
– REPLACE FLUID PACK, D-12
– SAMPLER JAMMED OR DEFECTIVE, D-14
– STANDARD A NOT DETECTED, D-5
– STANDARD B NOT DETECTED STANDARD C NOT DETECTED (9180/9181 only), D-6
– STATUS
– NOT CALIBRATED, D-5
– VALVE OVERTEMP! CHECK VALVES, D-13
– WHEEL MISSING OR SAMPLER DEFECT, D-13
ESD protection, A-8
– Conclusion, A-9
– Explanation of the phenomenon, A-8
– How can ESD protection be guaranteed?, A-9
– Influence of electrostatic charges on components, A-8
– Why is ESD protection so important today?, A-9

F

Fluidic Module, A-27
– Cleaning solution (9110 only), A-28
– Main tube set (all models)/ Intake tube set (9110 only), A-28
– Reference solution, A-28
– Sample Contacts (9110 only), A-29
– Standard A, A-27
– Standard B, A-27
– Standard C (not on 9110), A-27
– Waste liquids, A-28
Front door assembly, A-23

H

How to Use This Manual, 9

I

Important information, A-5
Important notes and warnings, A-6
Intended use, 3
Interface information, A-19
Interface specifications
– Data Link Information (9180/9181 only), A-20
– Example data string information, A-20
– Interface information, A-19
ISE SBC card, A-33

L

Lamp board, A-27, A-34

M

Main tube set (all models)/ Intake tube set (9110 only), A-28
Maintenance, C-9
– Annual preventive, C-9
– Daily, C-9
– Monthly, C-9
– Six month, C-9
– Weekly, C-9
Mechanical assemblies
– Display board, A-27
– Electrode holder, A-24
– Front door, A-23
– Lamp board, A-27
– Needle unit, A-23
– Peristaltic pump, A-24
– Printer, A-25
– Rear panel, A-25
– SBC board, A-26
– Solenoid, A-24

N

Needle unit assembly, A-23

O

Operating Parameters
– 9110, A-13
Operating Parameters 9120/9130/9140/9180/9181, A-14
Operating safety information, A-6
Other disinfectants, A-7

P

Peristaltic pump assembly, A-24
Printer assembly, A-25
Product data, A-15

R

Rear panel assembly, A-25
Reference solution, A-28

S

Safety information
– Important information, A-5
– Operating safety information, A-6
Sample Contacts (9110 only), A-29
Sample contacts adjustment (9110 only), C-5
Sample sensor adjustment (9120/9130/9140/9180/9181 only), C-5
SBC board, A-26
Service functions, B-65
– ENTER SERVICE CODE, B-67
– TEST AMPLIFIER, B-67
– TEST AUTOSAMPLER (9181 only), B-66
– TEST ELECTRODES, B-65
– TEST INTERFACE, B-67
– TEST LANGUAGE SWITCH (9180 and 9181 only), B-65
– TEST PINCH VALVES, B-67
– TEST PROBE (9181 only), B-66
– TEST PUMP, B-66
– TEST SAMPLE DOOR (except 9181), B-66
– TEST SAMPLE SENSOR, B-65
– TEST SnapPak SENSOR (9180 and 9181 only), B-65
Service Manual
– Abbreviations, 13
– Conventions used, 10
– Finding information, 9
– How to use, 9
– IVD symbols, 11
– Other symbols, 12
– Symbols, 10
– Version, 3, G-6
Software
– Version, 3, G-5
Software operation 9110, B-5
– Calibration sequence, B-15
– Daily maintenance menu, B-11
– Main menu, B-7
– Measurement sequence, B-8
– Operator functions menu, B-12
– Overall program operation flow, B-6
– Print functions menu, B-9
– Program instrument menu, B-13
– QC sample menu, B-10
– Service functions menu, B-14
Software operation 9120, 9130, 9140, B-19
– Calibration sequence, B-29
– Daily maintenance menu, B-25
– Main menu, B-21
– Measurement sequence, B-22
– Operator functions menu, B-26
– Overall program operating flow, B-20
– Print functions menu, B-23
– Program instrument menu, B-27
– QC/standard/urine sample menu, B-24
– Service functions menu, B-28
Software operation 9180, B-33
– Calibration sequence (Example Na/K/Li calibration), B-43, B-44
– Daily maintenance menu, B-39
– Main menu, B-35
– Measurement sequence, B-36
– Operator functions menu, B-40
– Overall program operation flow, B-34
– Power-up, B-45
– Print functions menu, B-37
– Program instrument menu, B-41
– QC/standard/dialysate/urine sample menu, B-38
– Service functions menu, B-42
Software operation 9181, B-49
– Automated measurement sequence, B-53
– Calibration sequence (example Na/K/Li calibration), B-60, B-61
– Daily maintenance menu, B-56
– Main menu, B-51
– Manual measurement sequence, B-52
– Operator functions menu, B-57
– Overall program operting flow, B-50
– Power-up sequence, B-62
– Print functions menu, B-54
– Program instrument menu, B-58
– QC/std/dialysate/urine sample menu, B-55

– Service functions menu, B-59
Solenoid assembly, A-24
Specifications
– 9110, A-13
– 9120/9130/9140/9180/9181, A-13
System interconnect - 9110, 9120, 9130, 9140, A-42

T

Temperature Adjustment (9110/9140/9180/9181 only), C-6
Trademarks, 4
Troubleshooting, D-5
– Status-LEDs, D-5

W

Waste liquids, A-28

Versions G

16 Versions G-3

Versions

This chapter provides information about the released software versions and the released service manuals.

In this chapter

Chapter **16**

Software G-5
Service Manual G-6
Version 1.0 .....G-6
Version 2.0 .....G-6

Software

Version Nr.	Release Date	Remark
A10X1.18	–	9110 only
A20X3.18	–	9120 only
A30X2.18	–	9130 only
A30X2.24	–	9140 only

Table G-1 9110, 9120, 9130 and 9140 software releases

For the 9110, 9120, 9130 and 9140 software, substitute *X* by one of the following language codes: English (E), French (F), German (D), Italian (I), Japanese (J) and Spanish (S).

Version Nr.	Release Date	Remark
A80X1.00	–	initial version for 9180 only
A80X2.00	–	9181 software included
A80X2.04	–	minor bug fixes and text changes
A80X2.05	17 May 2004	9180/81 SN > 12001 only "AVL" replaced by "Roche", minor text changes

Table G-2 9180, 9181 software releases

The 9180 and 9181 software was published as multi-language version.

Service Manual

Version 1.0

Version Nr.	Date of Release	Modified Chapters	Applicable from Software Version
1.0	July 2004	First edition	A80X2.05

Table G-3 Version 1.0 release information

Version 2.0

Version Nr.	Date of Release	Modified Chapters	Applicable from Software Version
2.0	April 2007	all	n/a

Table G-4 Version 2.0 release information

Chapter–Page	Modification / Addition
all	FrameMaker Templates applied for usage with iSDoc
(Preface) 10	symbols: updated
A-5	important information: protective equipment: updated
A-15	nominal power consumption: modified
A-20	data link information (9180/81 only): new
B-69	deleting data: new
D-5	Status-LEDs: new
Glossary, Versions	new

Table G-5 Version 2.0 modifications